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NEW SYSTEM OF MOVABLE DAM, WITH SWINGING WICKETS AND TRESTLES, AT LA MULATIERE, LYONS.

The accompanying engravings show the details of the movable dam recently constructed at Lyons, on the Saône, at its junction with the Rhone. In this structure the well known Chanoine system of swinging wickets has been followed, but the various modifications and improvements that have been introduced by M. Pasqueau, the engineer, have entirely excluded from the work, and iron has been substituted. In the upper part of each upright is inserted a swinging wicket, or "flutter-valve," held by a clasp when closed, and provided with an iron stop to cause it to maintain a constant angle with the uprights when open during the movements of the latter. It can be maneuvered very easily and rapidly from the foot-bridge by means of a boathook carried by a rod and pulley (Fig. 3). Each upright is supported by a quadrangular iron horse, the vertical pieces of which are prolonged below into journals which work in recess necessary to inclose them, after lowering, rapidly increased with the increase in height of the bridge. For instance, a bridge twenty feet in height above the sill would require the use of trestles twenty-four feet in height, and these when superposed on the bottom in six layers, would necessitate a depth of four feet in the recess to hold them. To obviate these difficulties, M. Pasqueau has constructed a wide span bridge, by placing the trestles 9·8 feet apart—one opposite each alternate upright (Fig. 5). The trestles, when down, are thus superposed in three layers only (Figs. 4

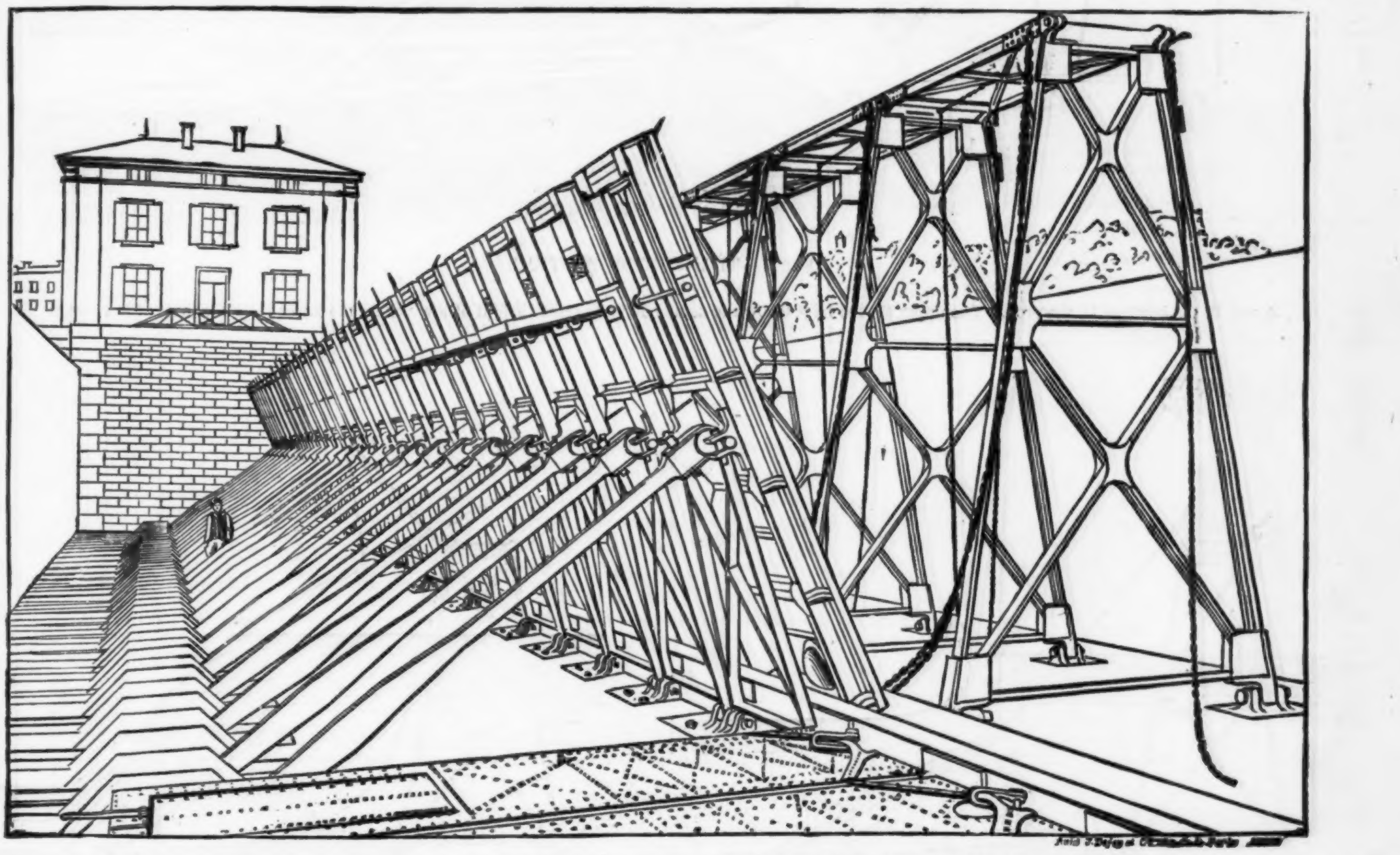


Fig. 7.—VIEW OF A PORTION OF THE NAVIGABLE PASS OF THE DAM AT LA MULATIERE, LYONS.

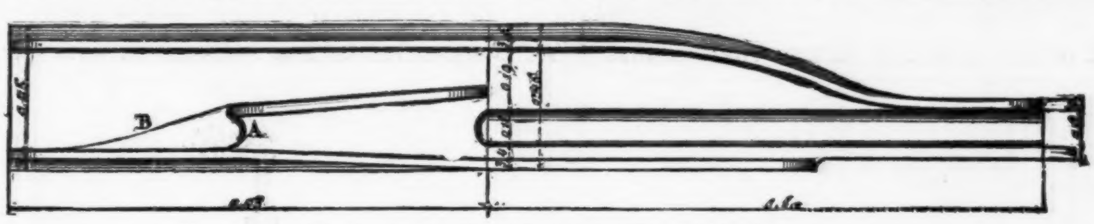


Fig. 8.—PLAN OF THE DOUBLE STEP HURTER.

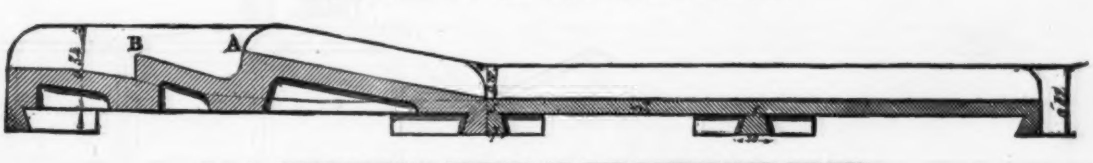


Fig. 9.—LONGITUDINAL SECTION OF THE DOUBLE-STEP HURTER.

MOVABLE DAM AT LA MULATIERE, LYONS.

entirely done away with the inconveniences and defects of that system as first adopted. Among the improvements in details which have been made, there is none more important than the suppression of the tripping bar, which has been replaced by an apparatus which M. Pasqueau calls a *double-stepped hurter*, in which, in addition to the ordinary notch, A (Figs. 8 and 9), there is a second one, B, the vertical face of which forms a very sharp angle with the axis of the guide. The operation of this will be described further on. As in the more modern forms of the Chanoine system, the dam consists of a series of uprights or wickets supported on quadrangular iron horses, and of a foot-bridge on trestles from which the wickets are maneuvered, and which itself is lowered to the floor of the dam after the wickets are down. As past experience has shown that wooden uprights (wickets) last only about ten years, this material has been Bessemer steel twin journal-boxes bolted to the sill of the floor. The upper cross-piece is prolonged into journals which work in journal boxes bolted to the frame of the upright. The cap of the horse has at its middle two wrought iron flanges traversed by a large bolt, by means of which a wrought iron prop is loosely fastened to the horse. When the horse is raised, the foot of the prop rests against one of the steps of the hurter already described; and, in this position, the horse and the prop form together a tripod of invariable shape, the summit of which supports the upright. Thus each upright has two axes of rotation, one at the bottom of the horse and the other at the top. The sill against which the breech of the upright rests is of cast iron, two to four inches thick, and will last as long as the floor itself.

Up to the present time the trestles have been made equal in number to that of the uprights, and the depth of the and 5), and by this means the depth of the recess is reduced to 2·6 feet, and it has been possible to increase the rigidity of the trestles while diminishing at the same time the total weight of the bridge, and also to limit to twenty-three feet the total height necessary to elevate it twenty feet above the hurter of the uprights.

The removal of the floor-planking and carrying it on shore every time the dam is lowered becomes impracticable with the weight that it is necessary to give it in dams having a high fall like that at La Mulatière. For this reason M. Pasqueau has hinged one end of the plank to each trestle so that when the latter is lowered to the floor the plank folds over and lies flat upon it (Figs. 5 and 6). Each trestle is provided at the top with two distinct axles, spaced thirteen inches apart. To one of these is hinged the plank, while the other serves for keying to the trestle the contigu-

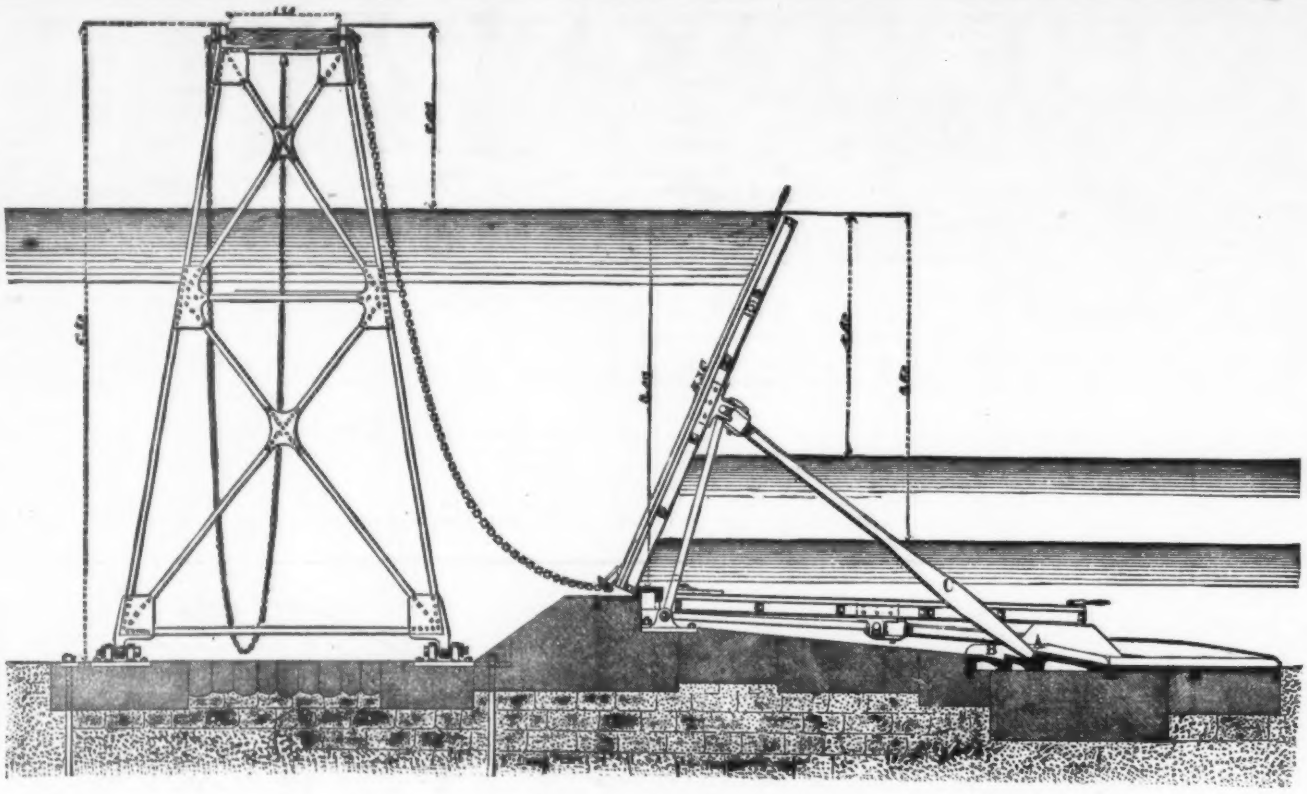


FIG. 1.—TRANSVERSE SECTION.

A and B, the hurters; C, the prop. The upper shaded lines below the dam show the present height of low water; the lower show the limit of low water.

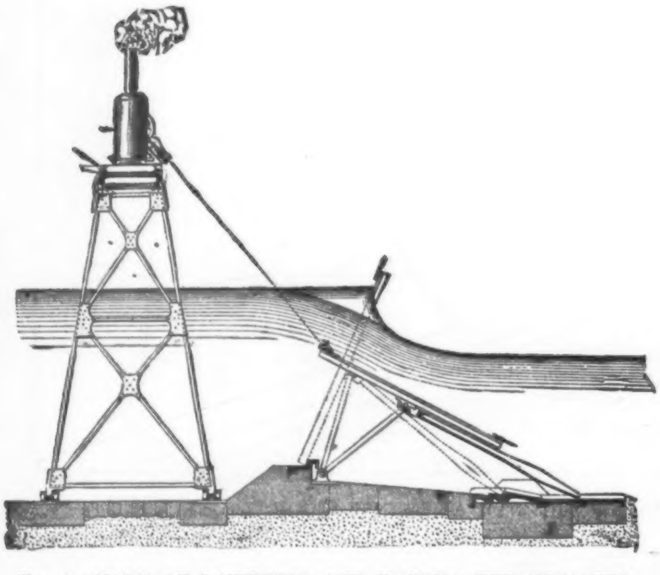


FIG. 2.—MODE OF LOWERING AND RAISING THE UPRIGHTS.

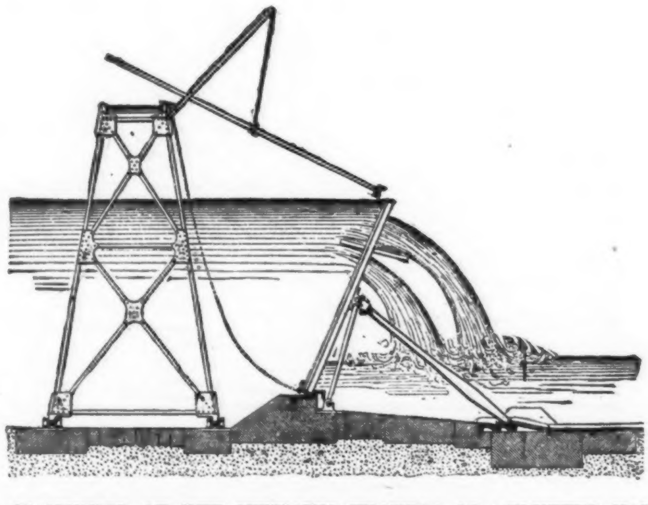


FIG. 3.—MANEUVER OF THE SWINGING WICKETS OR "FLUTTER VALVES.

FIG. 4.—MANEUVER OF THE TRESTLES.

MOVABLE DAM AT LA MULATIERE, LYONS.

ous plank. A guide rod attached to the windlass during the maneuver of raising the trestles receives the plank and leads it, as if by hand, to the bearing made to receive it, and to which it is then keyed. The raising of the trestles is effected by the help of a portable steam windlass (Fig. 4). To facilitate this maneuver, all the trestles are connected together by chains of suitable lengths, which are fastened at the end of each piece of floor. The operation of raising is begun at the abutment end. The portable windlass is fastened to this abutment in order to raise the first trestle; when this one is up the windlass is placed on it in order to raise the second trestle, whose chain has been brought to the surface along with the first trestle; and the operation is continued in the same way for all the successive trestles. During this maneuver the foot of the portable windlass rests on the cap of the trestle last raised, and its head is fastened to the cap of the trestle which precedes it.

The uprights are inclined at a certain angle (Figs. 1 and 7) for a twofold purpose—that of increasing the stability of the pass and of permitting them to arrive at their hurters without shock, and by their own weight, in spite of the resistance due to the weight of the maneuvering chains. They are raised in the usual manner. The lock keeper

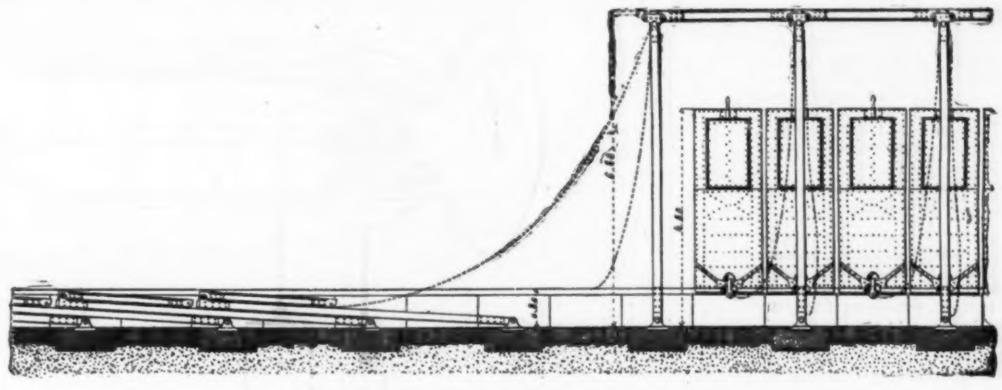


FIG. 5.—UP-STREAM ELEVATION.

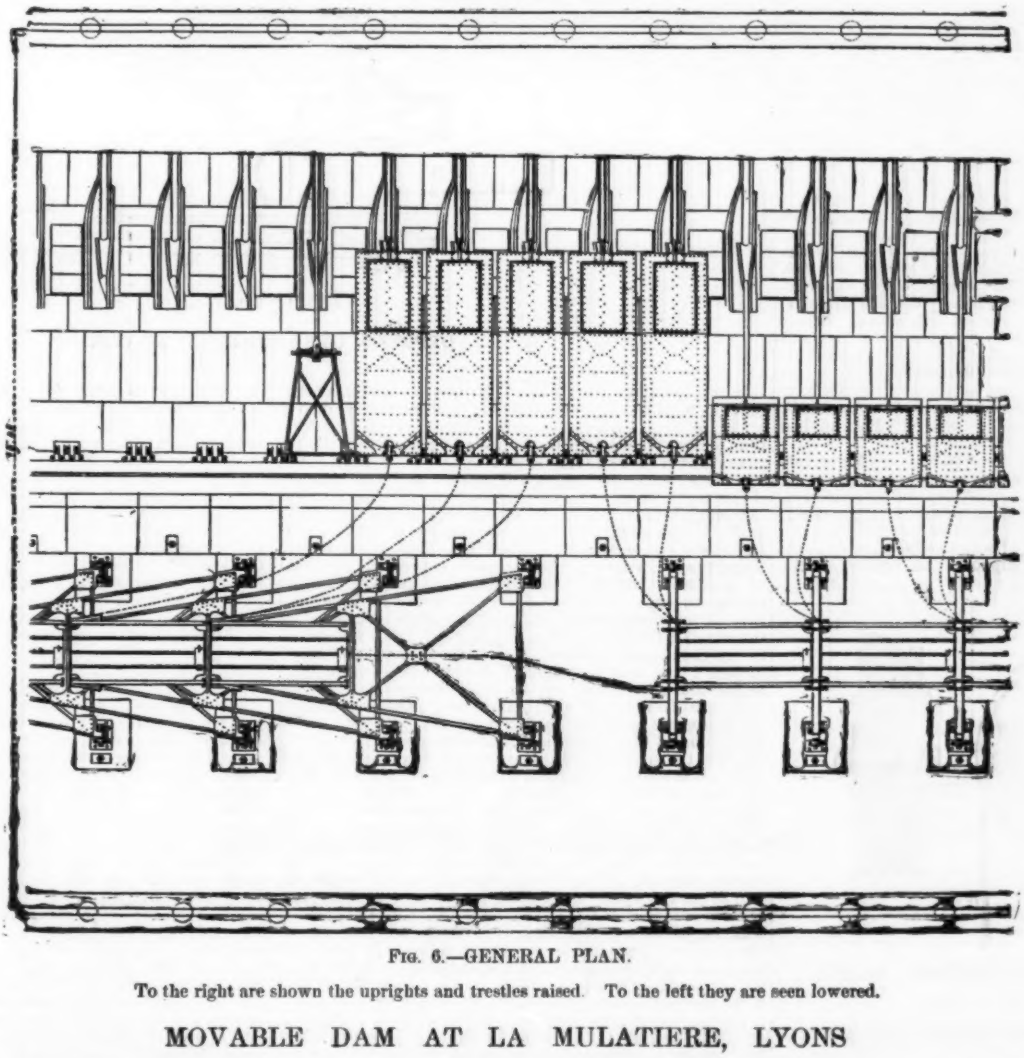


FIG. 6.—GENERAL PLAN.

To the right are shown the uprights and trestles raised. To the left they are seen lowered.

MOVABLE DAM AT LA MULATIERE, LYONS

draws up the breech chain until the prop, C (Fig. 2), falls into the hurter, A. He knows when this is effected, either by the sound made by the end of the prop as it falls in the notch, or by the arrival at the windlass of a link properly marked for the purpose. It is only necessary for him then to ease up on the chain, when the upright will swing to its proper position and bar the corresponding part of the pass. The lowering of the uprights is effected on a new and very simple plan, and by the use of the double stepped hurter spoken of above. It is only necessary for the lock keeper to draw in the breech chain in order to cause the upright to swing on its horse, and to continue the traction until the prop falls in the notch, B (Fig. 1), and then to slowly slacken on the chain. The prop directs itself of its own accord toward the channel of the guide by the action of the inclined plane forming the vertical face of the hurter, B, and the upright then falls gently on the floor of the dam without the least bit of shock. Doing away with the tripping bar and its accompanying inconveniences makes each upright independent of its neighbors, and with the new arrangement adopted the width of any pass may be made as great as may be desired; for each upright possessing within itself all the organs necessary for maneuvering it, it is possible to place several hundred of them in a row without the use of any intervening piles. This simplification might prove of great service in dams in course of construction on the rivers of North America, where the use of piles as at present leads to serious obstruction of navigation. Experiments already made at La Mulatière show that it takes but three minutes to lower each upright and two minutes to lower each trestle, and that each upright may be raised in five minutes, and each trestle in four minutes; or, in the whole pass of 4,078 feet, comprising 69 uprights and 34 trestles, maneuvered with the same windlass, the lowering can be effected in four hours and thirty-five minutes, and the raising in eight hours.

A WATER POWER RAILWAY.

A RAILWAY, possessing several features of much interest, has recently been inaugurated on the flanks of the Giessbach. As on Mount Vesuvius, the carriages are hauled by means of a rope running over a pulley and connecting the ascending and descending vehicles, both running on the same trunk line. The funicular system is, however, supplemented by a rack line like that on the Righi, but in another respect it differs from that line in that no mechanical power is employed in working it. The motive power is furnished by water filled at the summit into a receiver fitted to the vehicles, the quantity taken being that necessary at any time to give a sufficient preponderance in weight to the descending vehicle over that ascending, the water being emptied into the lake at the bottom of the mount. The line, and the stock and mode of working it, have been designed and constructed by M. Riggenbach, of Righi fame, and was commenced just two years ago. The line commences at the landing place of the steamboats on the lake of Brienz, and runs in a nearly right line up to the hotel, situated at a distance of 1,134 feet and a height of 305 feet, the gradient ranging from 24 to 32 in 100. Thence the line is straight until it reaches a crossing toward the middle of its length, where the two trains, ascending and descending, cross each other, by means of curves of 164 feet radii. The gauge is 1 meter, or 3·28 feet. The station at the foot is 127 feet above the steamboat pier, and is reached by a covered stairway, passenger luggage being pushed up by hand in a small wagon on a miniature railway. About half the Giessbach railway is carried on an iron viaduct of five arch spans, with a mean span of 124 feet, and supported on piers from 29 feet to 42 feet in height, the rails being fixed direct to the cross-girders. These cross-girders extend about 2 feet beyond the sides of the girders and carry a footway. On the other part of the line the rails are carried on oak sleepers placed directly on the ground 3 feet 3 inches apart from center to center. The sleepers receive longitudinal support from iron stringers or ties of U-section. They receive further support from the rack rail, which, like the Righi rail, is formed of two angle rails, connected by short square bars 1·86 square inches in section, riveted into the angle rails. The crossing which forms one of the features of the line operates automatically. The wheels of one vehicle forming one of the so-called trains have their flanges exterior to the tread, while the flanges of the other vehicle are interior. The rails on the left are continuous, while those on the right are cut so as to leave a space for the wheel flanges. By these means the vehicle with interior flanges arrives in ascending, for example, and, leaving the single trunk line common to both vehicles, is directed by the flanges to the right by the flanges rubbing against the left rail. The other vehicle is, on the contrary, directed by the branch which guides its exterior flanges toward the left. In the descent the operation is the same. The rack rail is bifurcated at the crossing, and lowered sufficiently to prevent the wheel flange from coming into contact with it. A groove is made in the rail to receive the rope at this crossing place. The rolling stock consists of two carriages and a goods wagon, the latter being always at the station siding for the purpose of the removal of heavy luggage. It is fitted with a windlass and gearing connected with the rack rail. Four men at the windlass raise three tons 164 feet in the hour with it. The carriages have each six compart

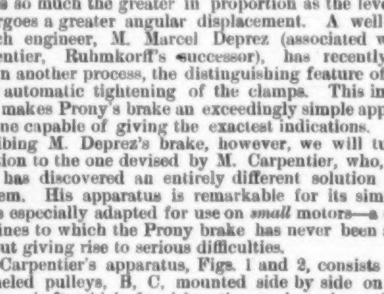
ments, one for baggage, and the others each contain eight seats placed transversely in pairs, each pair above the other, like stairs. The water vessels are placed under the platform, at the front end of which, extended, is the place for the driver, who can there command both the brake and the water outlet. The carriages have six wheels, the front pair of which is fixed to the axle and controlled by a brake, the rack line pinion being on the same axle. The other wheels are also fitted with brakes. Besides these brakes, which are operated by screws, the draw hook supports a weighted lever. So long as the hauling tension is on the rope the hook is held up; but when the tension ceases, as by the rupture of the rope, the lever drops under the weight and the hook immediately engages with the rack. The rope consists of five tresses of steel wire covering a body of hemp; it is capable of resisting without rupture a strain of 20 tons, which is six times that which ought to be brought on it in its work. The water used is collected in a reservoir at the top of the line from the Giessbach, and the carriage, on reaching the top, stops close to the tank, so that the driver can fill the receiver without quitting the platform. On reaching the bottom of the line the water is automatically emptied. The wagons weigh 6 tons empty, and at most 9 tons with forty passengers. An excess weight on the descending car of about 1·28 tons of water is required. The ascent or the descent occupies six minutes, and the different maneuvers about four minutes, so that the trains may follow each other at ten-minute intervals. The velocity on the gradients is 3·28 feet per second. Arrangements similar to some of those above described have been previously elsewhere employed, but there are several features of novelty and interest which the reader will have noticed.—*The Engineer.*

NEW DYNAMOMETRIC BRAKES.

PRONY'S friction-brake, by means of which the work transmitted by a revolving shaft is usually measured, makes known with exactness the result sought only as long as it maintains itself for a sufficient length of time in the same position of equilibrium. If, instead of remaining fixed, it cedes to the friction which tends to move it in one direction, or to the action of the weight which pulls it in the opposite, the lever of the apparatus is submitted to irregular oscillations which the operator has to overcome by continually modifying the pressure of the clamps; the consequence being that the measurement of the work transmitted is then only represented approximately. Now, this almost always happens, and, whatever be the precautions taken to insure a constancy of the friction, every one knows that it is very difficult, if not impossible, to practically realize that stability of equilibrium which the theory supposes.

Among the different artifices employed to give the lever the necessary stability is (1), that of sometimes placing the lever of the counterpoise beneath, and not above the revolving shaft—an arrangement which produces a slight augmentation of the lever arm when the brake cedes to the drag of the shaft; and (2), that of equalizing the friction, wholly or in part, by means of a graduated spring, which develops efforts so much the greater in proportion as the lever itself undergoes a greater angular displacement. A well-known French engineer, M. Marcel Deprez (associated with M. Carpentier, Ruhmkorff's successor), has recently made known another process, the distinguishing feature of which is the automatic tightening of the clamps. This improvement makes Prony's brake an exceedingly simple apparatus, and one capable of giving the exactest indications. Before describing M. Deprez's brake, however, we will turn our attention to the one devised by M. Carpentier, who, on his part, has discovered an entirely different solution of the problem. His apparatus is remarkable for its simplicity, and is especially adapted for use on *small* motors—a class of machines to which the Prony brake has never been applied without giving rise to serious difficulties.

M. Carpentier's apparatus, Figs. 1 and 2, consists of two channeled pulleys, B, C, mounted side by side on the revolving shaft which furnishes the work to be estimated. One of the pulleys, B, is fixed so as to stay in place, while the other, A, is loose. To the loose pulley are attached two cords, P, p, to the end of each of which is fastened a known weight. The cord, p, which supports the smaller of the



CARPENTIER'S DYNAMOMETRIC BRAKE.

FIG. 1.—Elevation. Front View.

FIG. 2.—Vertical Section through X Y.

weights, runs freely through the channel of the loose pulley; and the other cord is also attached to the latter, but in the plane of the fixed pulley, and runs in its channel. To effect this, the eye-bolt, R, to which the cord, P, is attached, is bent at right angles so that the eye stands directly over the channel of the fixed pulley. (Fig. 2, R.)

The arrangement of the apparatus being understood, if now the axle be made to revolve in the direction in which the weight, P, is acting, the cord which supports it will be submitted to friction from the loose pulley, and, in accordance with an experiment that every one knows and can again try, the difference of the tensions at the two extremities of the embraced arc will augment very rapidly in measure as this arc increases. The loose pulley will tend to move like the revolving shaft, under the effort exercised by the cord, P; but it is held back by the weight, p, which acts on the other cord, and equilibrium will be established, of itself, when the embraced arc will have assumed an amplitude that shall cause the tension of the cord (taken at its point of attachment) to be equal to p. Under these circumstances, the total friction exercised by the cord on the loose pulley is equal to the difference P—p, and the work developed per second is measured by the product of

$$(P-p)\times\frac{n}{60}\times 2\pi R,$$

in which, R is the radius of the sliding circumference, and n the number of revolutions per minute.

M. Carpentier's apparatus is particularly adapted, as before stated, to engines of small power (one to two horse, for example). It is not cumbersome, and works exclusively upon itself, without chance of endangering any one, as in the old-style brake. There are other uses to which it may be applied: for instance, if the materials employed to lubricate the cord and pulley be varied, the apparatus may be used as a machine for testing oils, and for determining empirically the lubricating qualities of different products. By causing the apparatus to operate in a calorimeter in such a way as to take up all the heat generated by friction, the work performed might be compared with the heat produced, and the mechanical equivalent of heat deduced therefrom.

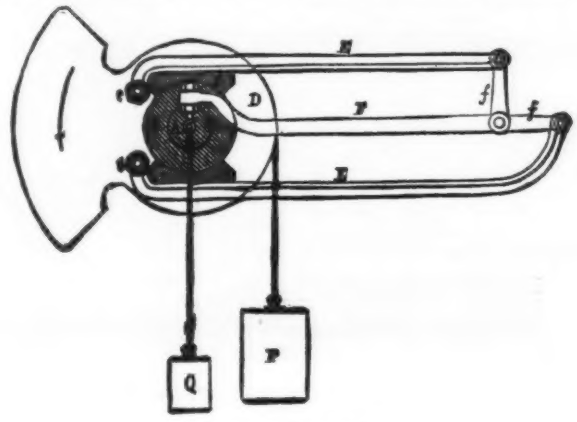


FIG. 3.—ELEVATION.

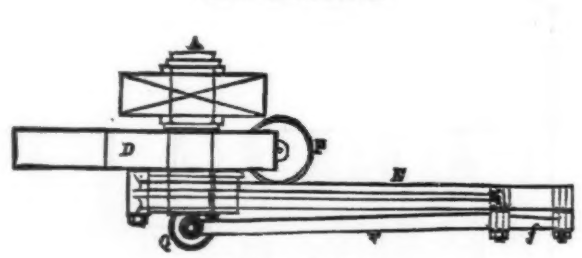


FIG. 4.—PLAN.

DEPREZ'S DYNAMOMETRIC BRAKE.

In the apparatus, Figs. 3 and 4, M. Deprez, instead of employing bolts and screws to tighten the clamps of the Prony brake, prolongs each of the clamps into a lever, E, E, and thus obtains what might be likened to a pair of nippers, between which the revolving shaft is gripped. A third lever, F, parallel with the others and placed between them, is connected with them by two jointed rods, *f f*. At its free extremity, which is situated on the axis of the revolving shaft, A, this middle lever carries a weight, Q, which hangs free at the end of a cord. This weight, designed for regulating the lightening of the clamps, is entirely independent of another weight, P, which equalizes the friction that the clamps undergo, and which alone will figure in the expression of the work sought. The weight, P, is suspended at the end of a cord attached to a pulley, D, which is fastened to the clamps and centered loosely on the revolving shaft in such a way that the weight, P, always preserves the same momentum with respect to the axis, whatever be the angle of inclination assumed by the apparatus. On the contrary, the tightening produced by the weight, Q, depends on the inclination of the brake, and varies proportionally to the sinus of the angle included between the levers and the vertical. It is null when the brake rises vertically, and is greatest when the latter is horizontal. Let us suppose that the tightening of the clamps has been regulated approximately for an inclination of the brake of thirty degrees on the horizon; it is clear that, if the friction accidentally diminishes, the brake, pulled by the excess of the weight, P, will become inclined still more; the effort due to the weight, Q, will at once increase; and the tightening of the clamps and friction of the shaft will be rapidly brought to the point at which equilibrium is restored. Let the friction increase, on the contrary, and the levers of the brakes will give, and the pressure of the clamps quickly diminishing, equilibrium will again be established. Since the sinuses of the angles, 0, 60, and 90 degrees, are respectively equal to 0, ½, and 1, it will be seen that the apparatus, regulated at an inclination of thirty degress for a friction of the axle represented by the number 1, allows of variations of friction between the extreme limits, 0 and 2. The apparatus is very sensitive, and the simplicity of its mechanism will permit of its application to all engines, whatever be their power.

CREMATORY FURNACES.

THE question of cremation is at present being earnestly agitated in France, and, at the suggestion of the Municipal Council of Paris, a committee has just been organized to investigate it in all its bearings. In view of this fact it may not prove uninteresting to take a rapid glance at what is being done in other European countries in this mode of disposing of the dead. Among the different processes, we will speak at length only of those actually in use, merely mentioning the experiments on which they are based. At Brussels, M. Melsens has experimented with an open furnace. The body to be cremated was placed in a retort, and the gases due to combustion were led through a tube to another furnace, where they were burned.

In Italy, M. Brunetti, Professor of Pathological Anatomy at Padua, constructed a furnace in which an adult was burned in two hours, but it was necessary to disintegrate the body to render incineration complete. At Lodi, Prof. Gorini has experimented with a liquid which, when elevated to a high temperature, was capable of dissolving organic matters. Besides this, he erected a reverberatory furnace, in which a body was completely incinerated in two hours by means of a current of hot air which furnished the oxygen necessary for complete combustion. This apparatus has already been in use ten times, and worked very satisfactorily—giving out neither smoke nor noxious gases. This process has been adopted at Woking, England, by a society organized to encourage the practice of cremation in that country.

At Milan, more than twenty cremations have taken place with the Polli-Clericetti apparatus; the first body cremated having been that of the Chevalier Alberto Keller, who left a certain bequest in his will for the construction of the furnace. This crematory apparatus is represented in the engravings on next page, in Figs. 1, 2, and 3. The furnace is placed within a small structure, the monumental shape of which is in keeping with the object of the apparatus. Behind this structure is situated a small gas works and all the apparatus necessary for compressing air. The interior of the apparatus is composed of a basement in masonry of Viggui stone, which, moreover, is used in the rest of the structure. Above this is built the crematory chamber, properly so called, consisting of two semi-cylindrical arches, having a space between them of four inches. The inner one, formed of refractory bricks, is six inches in thickness, and is strengthened by iron braces. The outer arch is built of common bricks. The air which circulates between these two arches prevents the loss of heat and helps to cool the outer walls of the apparatus. The body to be cremated is laid on a rectangular grating, *a* (Figs. 2 and 3), 6 feet long by 20 inches wide, composed of two frames and a series of iron bars, the ends of the latter resting in elongated notches so that they may expand freely when heated. Under the grating is placed an iron plate designed for catching the ashes, and which, like the grate, is fixed on rollers so that it may be readily removed from the furnace. The incinerating flame is obtained from a mixture of air and illuminating gas; consequently each jet is formed of two tubes soldered together. The flames are arranged in the following manner: Between the grating and the plate there is a horizontal bed of eighteen transverse rows, each comprising ten flames; twenty-seven others are placed above the grating in two ranks of eighteen burners each, arranged longitudinally to the right and left; another series, placed at the end of the apparatus, is directed on the head of the body to be burned; and, finally, eighty small jets of simple gas, distributed in three rows, are arranged under the ash-plate, in order to keep up the incandescence. In addition to the air which, injected under pressure, feeds directly each jet and increases its oxidizing power, the furnace receives a supply of external air by means of a flue, and the quantity of which is regulated from the gas works. This air, after traversing a plate pierced with holes located at the bottom of the crematory chamber, comes up under the grating and quickens the combustion through the oxygen that it brings with it. If still a greater amount of oxygen be necessary at any moment, it can be obtained by injecting compressed air through this same flue.

All the products of combustion arise to the top of the furnace, where, through an aperture, four by twenty inches, they pass into a closed pipe which traverses the air space between the two arches, and from there they pass through an underground conduit to the chimney. The mouth of the furnace is closed by an iron door, lined with refractory bricks, and decorated externally so as to correspond with the general ornamentation of the sarcophagus. This door is opened and closed by means of an apparatus located in the works, and once closed it cannot be opened from the outside. In the center there is an aperture through which the progress of the cremation may be seen. The gas furnace, *d* (Fig. 1), contains a 220-pound retort, which, after three charges, fills the gas meter, *h*, with gas. The latter is purified in a condenser at *f*. At *g* is the air-condenser, and at *e* is the distributer which regulates the admission of either the air or gas.

With this furnace cremation can be effected in an hour and a half, without odor or sound. A body weighing 130

Fig 4. Longitudinal Section.

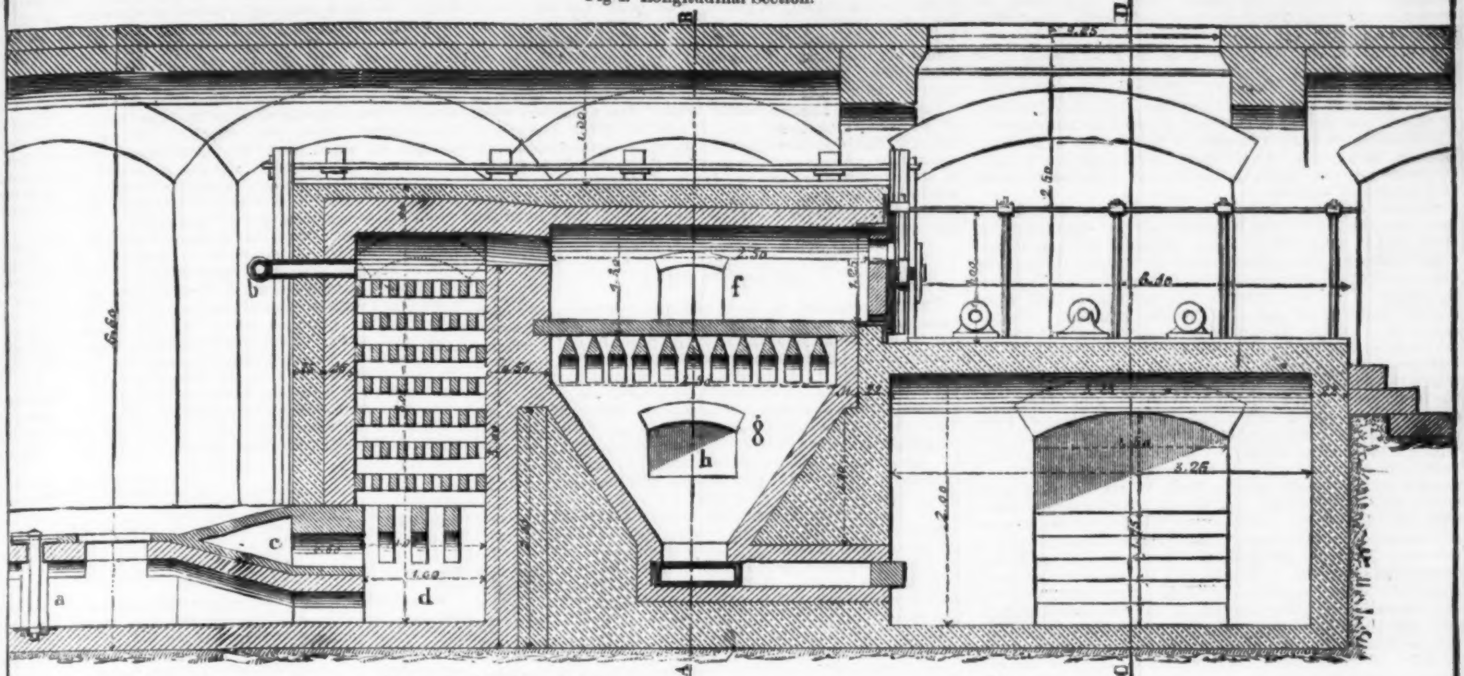


Fig. 5. Section through C D.

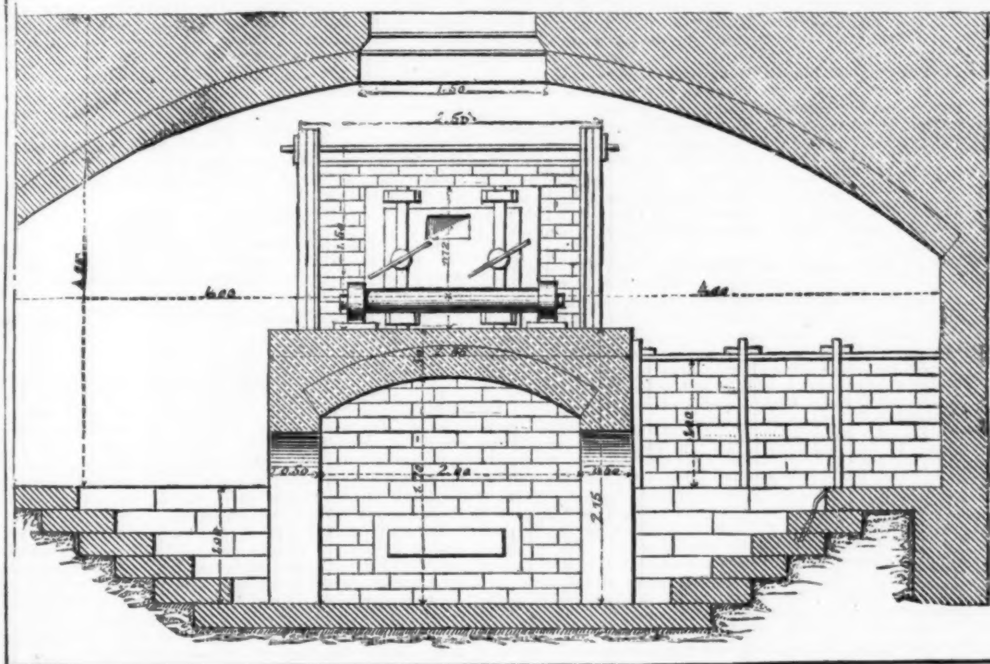


Fig. 6. Section through A B.

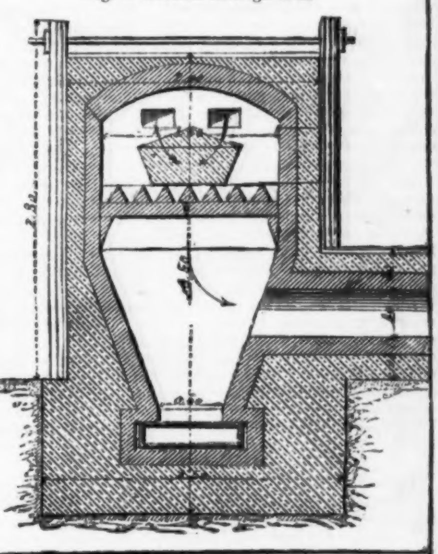
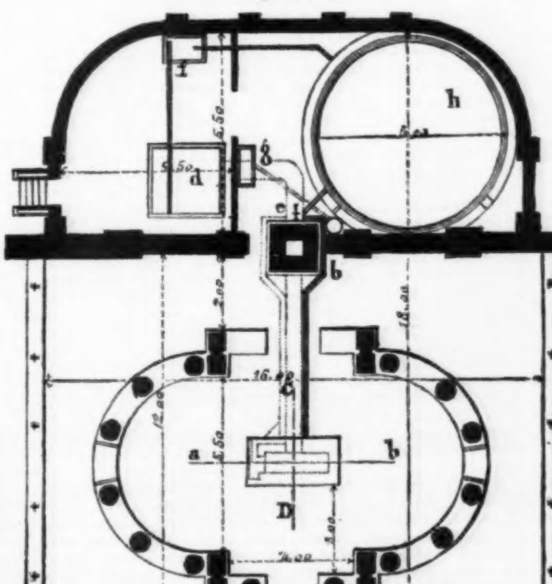


Fig. 1. Plan.



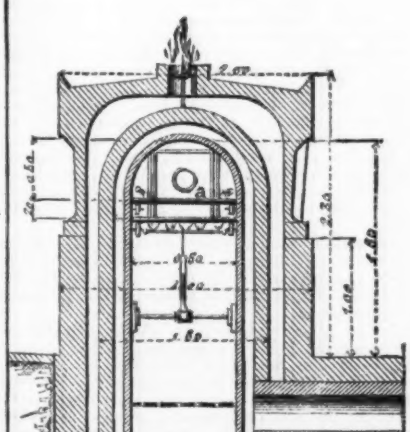


Fig. 2. Vertical Section through C D.

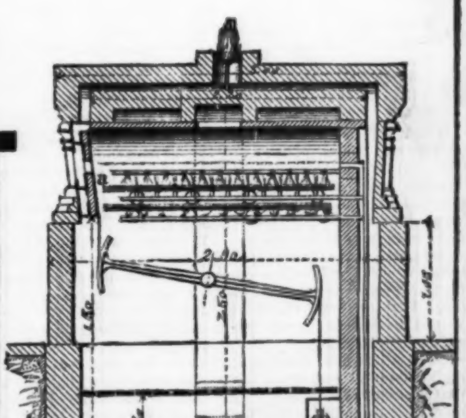


Fig. 3. Vertical Section through a b.

CREMATORY APPARATUS AT MILAN.—THE SIEMENS CREMATORY FURNACE.

pounds is reduced to about six and a half pounds of ashes. In Italy, as elsewhere, a physician has to certify that the deceased died from natural causes. Before authorizing the cremation the authorities take every precaution to ascertain that no crime has been committed.

At Zurich, Switzerland, where the Siemens system is in use, the ashes have to remain for twenty years in a distinct urn deposited at the cemetery. After that time, it is lawful for the nearest of kin to carry the urn to his dwelling. If this is not done the ashes are interred in the cemetery. The Siemens crematory furnace is also in use at Breslau, Dresden, and Gotha. In Germany, public opinion is daily becoming more favorable to this innovation on the old mode of disposing of the dead.

Siemens' furnace, which is shown in Figs. 4, 5, and 6, is based on the use of highly heated air for cremating the body, and is composed of a gas generator wherein is produced carbonic oxide, which enters the furnace through the flue, *a*, and the distribution of which is regulated by a valve. By means of an iron tube, *b*, the gas can be led, when needed, to the upper part of the heating chamber. The air enters at *c*, in the base of this heating compartment, *d*, which is merely a Siemens recuperator, composed of refractory bricks, arranged so as to form interspaces, through which the flames may circulate and part with their heat, the latter being afterwards taken up by the atmospheric air during the operation of cremation. The crematory compartment, *f*, is a chamber built of refractory bricks, into which is introduced, through a door in the front wall, the body to be cremated. Below the grate this chamber slopes inward on every side so as to form a sort of funnel, *g*, in which are collected the ashes, and which communicates with the flue of the chimney, *h*, hidden by the general decoration of the structure. The operation is performed as follows: First, the gas generator is filled with the proper combustible, the fire is lighted, and the gas evolved burns along with the atmospheric air in the lower part of the heating compartment. The mixture of the two gases is properly regulated by valves. During combustion the flames give up the greater part of their heat to the bricks, and the products of combustion, notably cooled, traverse the crematory chamber and then the refractory clay grate, and, finally, passing through the funnel (ash receiver), they reach the chimney. After the apparatus has been in operation for a few hours, and the sufficiently heated regenerator is red-hot throughout its whole extent, and the crematory chamber is at a pale red heat, the incineration may be begun. The body (contained or not in a coffin), is lowered by machinery, invisible to spectators, into the crematory chamber, which is then closed from the top. After the apparatus has been in operation for a length of time, depending on the size of the body, the gas-inlet valve is closed, and that which admits the air is opened wide. The air then enters the crematory chamber in great abundance after being heated in the regenerator, in contact with the hot bricks, up to the very temperature of the latter. This highly heated air then effects a rapid and complete combustion of the body without the evolution of fetid gases. Moreover, as a draught of the chimney is powerful, no gas can escape through the fissures. If the apparatus has been well heated before cremation, the operation may be effected in an hour, or an hour and a quarter. A small aperture in the door permits an employé to watch and regulate the whole process. When the latter is finished, the registers of the gas, air, and chimney are placed in their primary position; and, finally, the ashes contained in the ash-receiver are gathered up in an urn. While these are being gathered, the regenerator may, if necessary, be reheated and the operation be begun on another body. This apparatus, then, appears to satisfy all the exigencies of cremation, and has already been used quite a number of times. The weight of the ashes varies between three and a quarter and seven pounds, and the length of the operation never exceeds an hour, or an hour and a half. The expense of constructing the apparatus is about $5,000.

THE LIVADIA.

THE official speed trials of the Czar of Russia's yacht Livadia recently took place on the Clyde. On Friday the six hours' run took place, and on Saturday the measured mile trials. On both days the speed considerably exceeded that guaranteed by the builders, a result which is not surprising, and one that we foreshadowed when the vessel was still in course of construction. In the run from the Tail of the Bank to the South of Arran on Friday the vessel was timed between the Clocks Light and Cumbrae Light with a speed of 15 knots, and the speed by the log was 15½ knots. On Saturday there were six full-power runs over the measured mile, and the following are the results reported:

	Knots.
First run....	16
Second "	15·652
Third "	16
Fourth "	15·755
Fifth "	16
Sixth "	15·755

The mean indicated horse power is given as 12,383 horse power, and the mean speed as 15·864 knots.

It will be remembered that the vessel is 250 feet long and 153 feet wide, and that the estimated speed was 14 knots, the estimated horse power 10,500, and the estimated displacement 3,900 tons. All three elements have, we understand, been considerably exceeded. The engines developed nearly 2,000 horse power beyond the contract guarantee, and the speed is nearly 2 knots in excess. How much the displacement exceeds the estimate has not yet transpired, but it is clear that, without the 2,000 extra horse power, the speed would have been above 14 knots, notwithstanding the increased displacement. So far, then, it must be conceded, even by those who have scoffed at the Livadia, that the estimates made of her speed have been more than justified, and that an acknowledgment of the same is due to Dr. Tideman, on whose model experiments the estimates were based, and also to the builders, Messrs. John Elder & Co., Admiral Popoff, and the Russian officers, who have staked so much on those estimates.

In view of the extreme novelty of this vessel, it is much to be regretted that a series of progressive trials were not made on her for scientific purposes. It is one thing to make the requisite full-speed trials on the measured mile and on the six hours' run to satisfy the terms of a contract; it is quite another thing to make a really scientific series of trials at different speeds so as to record the variations in the vessel's resistance as the speed varies. The latter should be done for all vessels, and especially for vessels of novel type. It may be that the fear of Nihilist plots to blow up the ship might have caused the builders to hasten the transfer of her to her owners, and might have induced the Russian authorities to press for her delivery. This is a reasonable and intelligible explanation, and we can scarcely think that without some pressure of the kind Messrs. Elder & Co. would have missed so rare an opportunity of gaining what could not fail to have been some remarkable data on the resistance of vessels. As was to be expected, the vessel carried a very marked wave round her bow, and left the water much disturbed by waves behind her. The engines worked satisfactorily throughout, and we have not heard any rumors of heated bearings, which were of Parsons' white brass. The propellers were of Parsons' manganese bronze, and the great strength of this material, which enabled the blades to be made comparatively thin, and its smoothness of surface, doubtless tended in some degree toward the favorable results achieved. It would be interesting to know how far the slope of the propeller shafts from the horizontal line affected the trim of the ship during the trials.—*Engineering.*

SPECIFIC HEAT.

THE phenomenon of heat occupies, perhaps, the most prominent part in all our physical, chemical, or other scientific investigations; and in the ordinary routine of everyday life there is hardly an instance in which it is not either emitted, absorbed, or applied to obtain some desired result; yet if we are asked to state in definite terms the true nature of heat, we are compelled to confess our inability to do so. Two theories, however, have been advanced by different philosophers, but neither of them will explain satisfactorily all the different phenomena observed in heat; one theory explains one part of the phenomena, and the second one explains equally well the remainder.

The first theory assumes all space to be filled with one imponderable fluid or agent, made up of molecules, and that the evolution of heat depends upon either the emission of these molecules, or the transference by contact of one molecule to another, different substances having different affinities for them. This theory is also advanced to explain the theory of light. The second theory also assumes the existence of these molecules which are supposed to pervade all space and affect the densest mediums, but it accounts for the effects of heat by the vibration of these molecules—the hotter the body the more violent the vibration. The second theory seems to find most favor with modern philosophers, and it was strongly advocated by Rumford, Davy, and others, and more recently by the late Professor Clerk Maxwell, who, in his "Theory of Heat," says: "We must therefore admit that at every part of the surface of a hot body there is radiation of heat, and therefore a state of motion on the superficial parts of the body. Now, sirs, motion is certainly invisible to us by any direct mode of observation, and therefore the mere fact of a body appearing to be at rest cannot be taken as a demonstration that its parts may be in a state of motion. Hence, part at least of the energy of a hot body must be energy arriving from the motion of its parts. Every hot body is, therefore, in motion, the movements of the parts being too small to be observed separately."

From the impressions produced by touching or placing the hand near to a substance, we say that it is hot or cold, just as the sensations accord with what is commonly understood to be contained in those terms; but this does not in any way express the amount of heat or cold which is contained in the substance, and to this variation in the sensations of heat or cold we give the name temperature; in other words, temperature is that modification of heat which is perceptible to the senses, and can be measured by the thermometer. If we place a thermometer in a vessel holding a pint of water, say at 20°, and we place it in another holding a quart of water at 20°, the thermometer would indicate the same temperature in both cases; for although the quart of water contains twice as much heat as the former, it retains it with twice the force; as we shall show presently, and consequently only gives up to the bulk of the thermometer the same amount as the pint of water. We wish now simply to state that temperature must not be confounded with heat, for they are two distinct terms, and indicate very different things. Thermometers are used to determine the temperature of a substance, but it must be borne in mind that it can only give the relative quantities of heat contained in a substance as compared with that contained in another of the same or different substance.

If we take two glass vessels and place in one of them a pound of melted ice, and in the other one a pound of ground ice or snow, and place a thermometer in each of them, we shall find that the temperature of both is 32° Fahr.; but if we now place the two vessels over a spirit lamp, we shall find that as soon as the last particle of ice has been melted, the thermometer in the vessel which contained the melted ice will be standing at 172° Fahr., while the other one will be remaining at zero. Now, as it is evident that each of the vessels has received 140 units of heat, we naturally ask, What has become of the heat imparted to the pound of ice? The reply is, that it has become latent, and has been used up in melting the ice, and what is true for water holds good for other substances, which can be generally expressed by saying that when any body changes from a solid to the liquid state, a certain amount of heat is absorbed, or becomes latent, and in this form does not in any way affect the thermometer. The converse of this is also true, that is to say, when a liquid is changed into a solid state, a certain amount of heat is given off which can be proved experimentally in many ways. The most interesting experiment to demonstrate this is to fill a flask with a semi-saturated solution of sulphate of soda—with a thermometer immersed—and allow it to cool gradually in a place free from the slightest vibrations, where it will remain in a liquid state; but as soon as it is slightly tapped, or even if a violin be sounded close to it, the whole will immediately solidify, and the thermometer will at once indicate a rise in temperature.

We thus see that we have here a certain modification of heat which does not in any way affect the thermometer, showing that heat and temperature are two distinct things. This modification of heat is called latent heat, a further consideration of which we must defer for a subsequent paper. We have, however, another modification which we now propose to discuss more fully.

If we take a vessel containing a pound of water, say at 50°, and pour into it another pound of water at 50°, the temperature of the two combined will remain at 50°; again, if we take a pound of water at 50°, and mix with it a pound of water at 100°, the temperature of the mixture will be an exact mean of the two, viz., 75°. If we take a vessel containing one pound of water, or any liquid, or a pound of any material, as a bar of iron, and also take a vessel containing 10 lb. of the liquid, or 10 lb. of the material, and expose them to the same source of heat, we shall find that when the pound has risen 50° in temperature, the 10 lb. will only have risen 5°, and we thus conclude that the amount of heat required to raise weights of the same substance to a given temperature is distinctly proportional to their weights. But if we now take, say a pound of water and a pound of mercury, and expose them to the same source of heat, we shall find that when the water has risen 1°, the mercury will have risen 30°, showing that equal weights of different materials, although indicating the same temperature, contain different quantities of heat. We thus see that it requires a less amount of heat to raise mercury 1° of the thermometer than it requires to raise the same amount of water, and we thus say that water has a greater capacity for heat: and as a matter of fact it is found that water has a greater capacity of heat than any known substance, and for this reason it is made the standard by which all other substances are compared.

We have just shown that it requires one unit of heat to raise mercury 30° of temperature; therefore, by calling a unit of heat the amount of heat required to raise one pound of water 1° in temperature, it must require only $\frac{1}{30}$th part of a unit, or 0·0333 to raise 1°, and in a similar manner we can ascertain the practical part of a unit of heat required to raise one pound of any other substance 1° in temperature. This fractional part is commonly called the "specific heat" of the substance, and in the following table we give the specific heat of a few substances as an example. One pound of each of the following substances is supposed to have been exposed to the same and equal source of heat, and when the water has risen 1°, the other substances will have risen as follows, viz.:

	Temperature.	Units of heat required to raise the substance 1°, or specific heat.
Water	1°	1-1 = 1·000
Sulphur.... ...	4·9	1-49 = 0·203
Iron	8·8	1-88 = 0·114
Silver...	17·5	1-17·5 = 0·051
Mercury.........	30	1-30 = 0·33

It will thus be seen that sulphur has a capacity for heat, 4·9 times less than water, that is to say, at the same temperature, water contains 4·9 times as much heat.

There are two methods of determining the specific heat of a solid or liquid, the first being called the "method of mixture," the second, the "method of cooling." The first method consists in heating one substance to any observed temperature, and thus immersing it in a vessel containing a known weight of cold water at any given temperature; then the amount of heat which is given to the water will be proportioned to the specific heat of the substance, and we can thus readily calculate it. For example, if we take a pound of water at say 156°, and mix with it a pound of mercury at 40°, the resultant temperature will be 152·3°; we thus see that while the temperature of the water has only fallen 3·7, that of the mercury has risen 112·3°, and assuming the specific heat of water to be the standard, that of the mercury will be 0·033 for

$$112·3 : 3·7 :: 1 : 0·033.$$

Again, if we heat a bar of copper weighing 1 lb. to 300°, and immerse it in a pound of water at 50°, the resultant temperature of the two substances would be 72°, the copper thus having lost 228° and the water gained 22°, and taking water as the standard, the specific heat of the copper would be 0·096 for

$$228 : 22 :: 1 : 0·96.$$

When determining the specific heat of substances by this method, there are many difficulties to be overcome to obtain accurate results, owing to the many sources of error; for instance, the vessel which contains the water must necessarily receive or give off heat when the mixture takes place, and would thus affect the result if it were not taken into consideration. Full details of all these points are given by Regnault, Dulong, and Petit, in their papers published in the *Annale de Chimie et de Physique.*

The method of cooling is based upon the fact that the time required for equal weights of different substances to cool through the same number of degrees is proportional to the amount of heat which they contain; that is to say, to their specific heat. The difficulty in applying this principle consists in obtaining precisely the same condition for all the substances, although Regnault devised a very ingenious apparatus for the purpose, and used every precaution, and utmost perseverance, yet the results obtained by him were so very unsatisfactory that the method is hardly worth considering further.

From the observations of Regnault, Dulong, and Petit, the following general results have been obtained, viz.:

(1) The specific heat of a substance bears close relation to the atomic weight.

(2) The specific heat of the same substance increases with the temperature. This is also true for water, which is our standard, but on the ordinary range of temperature during which an experiment is conducted, it varies to such a slight extent that it may be neglected, though accurately speaking, the unit of heat ought to be the quantity required to raise water from 32° Fahr. to 33° Fahr. This alteration in our specific heat may be due to the expansion of the substance, the molecules being then placed farther apart, and upon comparing a table of the rise of specific heat owing to the rise of temperature with a table of expansions, it will be found that they correspond. The specific heat of liquids varies to a much greater extent with the temperature than solids.

(3) All substances have a greater specific in the solid than in the liquid state; this is no doubt due to the fact that liquids have a greater rate of expansion than solids, hence the quantity of heat absorbed in producing this mechanical effect is also greater.

(4) Anything which increases the density of a solid, decreases its specific heat; for instance, when copper is annealed its specific heat is 0·095, but after its density has been increased by hammering its specific heat will be found to have fallen to 0·093. It may be partly owing to this diminution in the specific heat of a substance when compressed, that bars of iron or other metal when passing through rollers become heated, for being thus compressed, they have not the same capacity for heat, and give off what they cannot retain. When uniform bodies are suddenly compressed, in like manner, a large amount of heat is evolved, which is illustrated by the well-known experiment of igniting a piece of timber placed at the bottom of a small cylinder by suddenly compressing the piston. On the other hand, when air is suddenly rarefied, the opposite effects are observed; for instance, on exhausting the cylinders of an air pump, a slight mist is found inside, and for the following reason: All air contains a certain amount of moisture, and the sudden rarefaction of the air in the receiver deprives the moisture of a large amount of heat which it originally contained as being necessary for its existence in the gaseous state, it thus condenses in minute drops in the form of mist. Another familiar illustration of this

is observed when using the diving bell; as soon as the bell begins to ascend it is filled with mist, which gradually disappears as the equilibrium is restored. This phenomenon is also observed in compressed air engines; for as the exhausted air is turned into the atmosphere, it is of course suddenly rarefied, and a jet of fine spray proceeds from the mouth of the pipe.

Numerous other illustrations could be mentioned, but enough has been given to illustrate the points under consideration. It is owing to the cause just explained that a progressive diminution in the temperature of a column of our atmosphere is observed as the altitude increases, and the difference is so much, that in the hottest summers the tops of most of the huge mountains are perpetually covered with snow.

This decrease of temperature amounts to 1° Fahr for about every 300 ft.; and we thus see that if a blast of air were to descend from the top of one of our highest mountains, before reaching us in the plain below it would have been wasted to a great extent by the condensation it would undergo in its descent, but by a wise provision of nature we are saved from the ill effects which might otherwise ensue.

GATE FROM THE INCLOSURE OF THE TABOR PROMENADE IN RENNES, BRETAGNE.—DESIGN OF J. B. MARTENOT.—*From the Workshop.*

(5) Liquid water has the greatest specific heat of any known substance, in fact for the same temperature it contains the greatest amount of heat of any known liquid or solid; and this wonderful property makes our oceans grand reservoirs of heat, and consequently they exert a great influence in moderating and equalizing the temperature of our islands and continents. Mercury, on the other hand, has the least capacity of heat of any known substance, and this fact makes it well adapted for the construction of thermometers, as with the least variation in the temperature its column is affected.

In determining the specific heat of gases great practical difficulties present themselves, and until lately none but very erroneous results have been obtained. Regnault, however, re-investigated the matter, with specially designed apparatus, and having obtained the specific heat of most gases, came to the following conclusions:

(1) The specific heat of gas does not vary sensibly with the temperature.

(2) The specific heat of gas does not vary with the pressure, and hence it is the same for all densities.

It will be observed that the above conclusions are directly opposite to those obtained for liquids and solids.—*Universal Engineer.*

NEW THERMOPILE.

PROF. S. P. LANGLEY has invented an instrument far more sensitive than the thermopile for the measurement of radiant energy, and which is expected to be of general utility. It was described by him at the recent meeting of the National Academy of Sciences in this city. The principle of the new apparatus has been applied by Dr. Siemens and others to other purposes. Professor Langley spent several months in making it, as he hoped, a useful working tool for the physicist and the physical astronomer. It is founded on the principle that if a wire conveying an electric

current be heated, less electricity flows through it than before. If two such wires, carrying equal currents from a powerful battery, meet in a recording apparatus (the galvanometer) the index of the instrument—pushed in two opposite ways by exactly equal forces—will remain at rest. If one current be diminished by warming ever so little the wire which conveys it, the other current gets the upper hand, and the index swings with a force due, not directly to the feeble heat which warmed the wire, but to the power of the battery which this feeble heat controls. The application of this principle is thus made: Iron or steel is rolled into sheets of extreme thinness. The speaker said he had succeeded in rolling sheets of steel made at the works of Miller & Parkin, Pittsburg, Penn., until it took 8,000 of them to make the thickness of an inch. Specimens of these sheets were exhibited, together with platina, rolled at the United States Mint in Philadelphia, even thinner. Of these sheets fifty laid one on another did not together equal the thickness of light tissue paper. Minute strips, 1-32 of an inch wide and ¼ of an inch long, cut from this were united so as to form a prominent part of the circuit, through which a current of a powerful battery passes to the galvanometer. Experiments proved that an almost inconceivable minute warming of a set of these strips would reduce the passage of the electricity, so as to produce very large indications on the registering instrument. Professor Langley had in the course of his experiments thus far, he said, found iron the most advantageous, though other metals were still under trial. The instrument thus formed was from ten to thirty times more sensitive than the most delicate thermopile; but this was almost a secondary advantage, compared with its great precision and the readiness with which it is used. The thermopile is very slow in its action. This new instrument, the thermal-balance, takes up the heat and parts with it again in a single second. It is almost as prompt as the human eye itself. To show its accuracy, Professor Langley gave experiments which proved that the probable error of a single measurement made with the instrument could be reduced within one per cent. of the amount to be measured. To show its sensitiveness, the statement was made that it would register a change in the temperature of the iron strips, just described, which did not exceed one-fifty thousandth part of a Fahrenheit degree. When mounted in a reflecting telescope it would record the heat of a man or other animal in a distant field. It would do this equally well in the night, and might be said, in a certain sense, to give the power of seeing in the dark. A more valuable proof of its efficiency was shown in a series of measurements of the heat of the moon, made under varied circumstances, to guard against error, but each made in a few seconds. All agreed in showing that the almost immeasurably minute amount of heat from the moon could be certainly measured by it, even with a common refracting telescope.

TRACING THE PENDULUM.

AT the last session of the American Association, Professor Mayer said: Last year, in the month of October, I mounted in the physical laboratory of the Stevens Institute of Technology a Foucault pendulum formed of a cannon ball suspended by a steel wire. By floating the ball in mercury I determined the point on the ball to which the wire should be attached, so that this point and the center of gravity of the ball should be in the same vertical line. This line, having been prolonged as a diameter of the ball, determined the spot into which I screwed a pointed index. The point of this index, when the ball was stationary, was about $\frac{1}{16}$ of an inch above a piece of smoked paper placed on a plate of metal which had been carefully brought into a horizontal plane. The pendulum was now drawn from the vertical by the tension of a delicate cord, one end of which was attached to the ball, the other fastened to a fixed support. The pendulum was started in the usual manner by burning this string. After a few oscillations a current of electric sparks from an induction coil was passed through the suspending wire, and from the point of the index of the pendulum through the smoked paper to the metal plate, and thus was obtained a trace of the path of oscillation of the pendulum. At successive and known intervals of time I obtained similar traces, which were rendered permanent by passing the smoked paper through spirit varnish.

Last May I described this experiment to Professor Cross, of the Massachusetts Institute of Technology, and he then informed me that the same idea had occurred to him, though he had not put it in practice, and also that he had recently mentioned this plan of experimenting before the American Academy of Arts and Sciences in Boston; therefore his name and mine should be always associated in designating this method of obtaining a permanent trace from the Foucault pendulum.

NEW AIR THERMOMETER.

By M. MILLER.

THE apparatus is constructed of an iron support fitted at its upper part with two tubulures, in which are fixed the two tubes of the manometer. The closed branch bears a thread of opaque glass, soldered in its side at the point where the large tube joins the connecting tube.

LIGHTNING RODS ON WAR SHIPS.

THE Lords Commissioners of the Admiralty direct that in future the captains and commanding officers of Her Majesty's ships and vessels are to be held responsible for ascertaining that the continuity of the lightning conductors on board the ships and vessels under their command is complete, and also for maintaining such lightning conductors in a state of efficiency. In ships which have galvanometers on board the conductors are to be tested periodically, and in ships which are not supplied with such instruments the commanding officer is to apply for the conductors to be tested, when an opportunity offers, at a dockyard.

IMPROVEMENT OF THE BUNSEN BATTERY.

THIS improvement, made by Mr. Azapis, consists chiefly in replacing the acidulated water in which the zinc is immersed by a solution of about fifteen per cent. of cyanuret, either of potassium, of caustic potash, of sea salt, or of ammonia salts. The liquid in the porous vessel which contains the carbon plate remains the same as usual. This improvement has the advantage that, while the intensity of the current is the same as in the Bunsen element, the zinc plates do not need to be amalgamated, and the consumption of zinc is considerably less, while the constancy and the durability of the current are remarkable. A battery improved in such a manner, which consisted of twenty-five elements, and in which ordinary ammonia salts were employed, was used without interruption for four days in succession, and during the evening for the purpose of producing an electric light. Another advantage of the battery is that it gives out very little odor.

ELECTRIC LIGHTING.*

ALMOST two years ago I had the honor of delivering a lecture in this place on electric light. To-night I have undertaken to report the progress which has been made since then in connection with the subject. At the time of my last lecture the public mind was greatly perturbed by the question whether or not gas lighting was about to be superseded by electric lighting. It was generally believed that a revolution-working discovery had been made, and you may remember, as a consequence, gas stock was much depressed in value. After a while, when the supposed wonderful discovery dwindled and paled in the daylight of scientific examination, the panic subsided, and then the current of feeling drove the other way, and in place of the hasty credulity which at first took possession of the public mind, there is now, I think, an equally unreasonable unbelief in the possibilities of electric lighting—the idea now widely prevailing that electric light, as a substitute for gas, is after all a delusion.

[A brief résumé of the general principles was here given, and the development of the dynamo machine shown.]

On the whole the cost of producing electricity by mechanical means has been diminished.

It is practicable to develop 1 horse power by the combustion of 2 lb. of coal per hour, and to produce with this amount of motive power a current of electricity sufficient to give a light of over 1,000 standard candles; that is to say, we can maintain for one hour an electric light more than equal to 1,000 standard candles, or 66 large gas burners, by the combustion of 2 lb. of coal. That is a much more economical result than can be obtained by the voltaic battery or any other means of generating an electric current at present known. [Reference was made to the voltaic cell, and the question of storage was discussed as exemplified in the secondary battery of M. Planté.] M. Planté was, I believe, the first to put the idea of a secondary battery into practice. The secondary battery of M. Planté consists of plates of lead placed opposite each other and very near together, but not touching. Here is a Planté cell. It consists simply of two pieces of sheet lead rolled up together, and separated by the space of about one-eighth of an inch. You observe that in this combination we have two plates of the same metal, viz., lead; and in this respect the combination differs from an ordinary voltaic battery, inasmuch as the very essence—so to speak—of the voltaic battery is the dissimilarity of the two plates which in part constitute it. It is zinc and copper, or zinc and platinum, or some dissimilar combination of that sort that we are all familiar with as characteristic of the voltaic battery. Here, in the secondary battery, the two plates are alike, therefore of themselves they cannot generate a current of electricity like the ordinary voltaic battery. But if these two lead plates are for a time connected by wires with a generator of electricity, no matter of what kind (it may be a dynamo-electric machine which supplies the primary current) one of the lead plates is changed on its surface—it becomes oxidized—and after undergoing this change, it is, when detached from the generator, in such a condition as to be able to give out, at any future time, a current of electricity on its own account; and when the charge has been expended the plates are, like an empty gasometer, just in the same condition they were before receiving the charge, and ready to be charged afresh. The secondary battery is, therefore, an instrument of very great interest at the present moment, and it is much to be hoped that it may be improved, because, in the simple form which I have described, it does not quite do all that would be required of a secondary battery, applied as a store of electricity on a large scale for extensive practical electric lighting. I have here a modified form of a secondary battery, which, if it does not give us all that could be desired, makes a very considerable contribution toward it. This battery was charged this morning; before being charged it was nearly inert. I will join the poles together by this platinum wire, and if the charge has been retained the wire will become hot. [The wire is, you see, white hot.] The want of a means of storing electricity is a newly felt want; as yet it cannot be said to have been fully supplied, but, as I have shown you, it has been supplied to a certain extent, and research is still busy at work seeking its complete fulfillment. There can be no doubt that what is wanted will be found, and with the perfecting of the secondary battery that great objection to electric lighting—that you cannot store the power which produces it as you can store gas—will be completely met.

[The thermopile was here briefly referred to.]

All the various means of producing light by electricity that can make any pretension to practicability are divisible into two classes, namely:

1st.—Lighting by the electric arc.
2d.—Lighting by incandescence.

In lighting by the electric arc there is a break or gap in the circuit which has to be bridged over by a sort of electric flame. In lighting by incandescence there is no break or gap at the point where light is produced, but a thin, highly infusible, and badly conducting solid substance is there interposed which becomes white hot, and emits a light, bright in proportion to the degree of heat produced in it.

Now, to fix in your mind precisely what I am talking about, I will first show you what I mean by the electric arc. This will enable you more easily to follow my remarks on the question of electric lighting by this method.

Here is an enlarged view of the electric arc—here are the two carbon points, and here—between them—is formed the electric arc.

A powerful electric current, produced by a gas engine and dynamo-electric machine, is supplied to these two pencils of carbon through thick copper conducting wires, and you see that a stream of flame is flowing or rushing between them. If the points are too much separated, the light is lessened; by increasing the air space between the points resistance to the passage of the current is increased, and the current is consequently diminished, and when this diminution of current passes a certain limit the light is lessened. On the other hand, when the points are made to approach too closely to each other, the light becomes less for the opposite reason.

A certain amount of difficulty or resistance must be offered to the passage of the current in order to produce light, and to get the best effect the resistance must neither be too much nor too little.

When the points are made to touch there is no longer the resistance of the air space to be struggled through, the light consequently goes out.

Observe the alteration in the points; they burn away, and one faster than the other. Now, as the production of a steady light demands that the points should be maintained at a constant distance apart, it is evident that under the complicated conditions of the case, a nice regulation of the distance of the points to each other is a matter of extreme difficulty.

I will now ask for the current to be turned on to a lamp hung up aloft, in order that you may see how very nearly the difficulties of producing a steady arc light have been surmounted.

The particular lamp I am using for the purpose of my illustration is Crompton's lamp, of which here is a diagram. Properly regulated it feeds the pencils together almost continuously and with great precision.

That, then, ladies and gentlemen, is *par excellence the electric light*. That is the form and style of electric light that inventors have for the last forty years struggled and battled with difficulty upon difficulty to render serviceable to the wants of man.

From the nature of the electric arc light you will readily perceive that it is a kind of light not suited to the lighting of dwelling houses, nor shops, nor streets.

It does not lend itself kindly to division nor extensive distribution. It will give you either a great deal of light or none.

For certain exceptional uses it is excellent. If you want a very brilliant illumination all centered in one focus, for a lighthouse, or signal, for example, or for a high-roofed railway station, or very large workshop, or open space, it is unquestionably the most economical and the best of all artificial lights.

It has already found for itself in England over two hundred appropriate applications. Its use is continued and increased on the Thames Embankment. It is used in the reading room of the British Museum; in the Picton Library, Liverpool; in a portion of the South Kensington Museum; at the Liverpool Street Railway Station; the Barrow Shipbuilding Works; the St. Enoch Railway Station, Glasgow; on the Promenade at Blackpool; and at the New Albert Docks, where, by means of Siemens lamps, three miles of wharves and quays are made almost as light by night as by day, and at a very moderate cost.

As an illustration of the economy of lighting by means of the electric arc under conditions suited to its use, I instance the case of the Alexandra Palace, where 2,000 gas lights, which consumed 26s. worth of gas per hour, are replaced by six of Mr. Crompton's lamps, giving a greater aggregate amount of light than the 2,000 gas burners, at a cost of 6s. per hour. In some instances the economy of the electric arc light is greater by half than in the case I have mentioned. Not only is it economical in such a case as that of the Alexandra Palace, but it produces an effect of general illumination overhead as well as upon the ground not producible by any other means.

But the interest which attaches to electric arc lighting is much lessened by the fact that the purposes to which that mode of lighting is suited are exceptional. We do not, as a rule, want the light of 1,000 candles or more all in one place. What we do generally want is a number of small and steady lights, spread about in different rooms, and in different parts of those rooms. For electric light of this description we must search in another direction.

I said that there is another way of producing electric light: namely, by incandescence.

Lighting by incandescence is a branch of the subject which has a special charm for me, because I have bestowed upon it much thought and labor; and it is, I believe, the branch which will yield the largest crop of fruit. Electric lighting by incandescence is just as simple as arc lighting is difficult; all that is required is a material which is not a very good conductor of electricity, highly infusible, and which can be formed into a wire or lamina, and is either non-combustible in air, or, if combustible, does not undergo change in a vacuum. There are, so far as I know, just two substances that possess, in any sufficient degree for the purpose in question, the qualities I have specified.

The two substances are: Platinum, or an alloy of platinum with iridium and carbon. Platinum has the advantage over carbon that it is not combustible in air; it does not, like carbon, burn away if you make it white hot; but it is very inferior to carbon in the degree of heat it will bear without fusion; and for producing light by incandescence it is essential to economy that the incandescent material should be capable of enduring an extremely high temperature, because the amount of light emitted by an incandescent substance increases in a more rapid ratio than the temperature.

When, for example, you have a piece of platinum wire or carbon red hot, it emits almost no light, but double its temperature by sending a double quantity of current through it, and it will yield much more than twice the light it did before.

It is, therefore, evident that the hotter the incandescent material can be made the less the light will cost per unit of power expended.

Iridio-platinum, comparatively with other metals, may be called extremely infusible, but compared with carbon it is nowhere. Carbon has, in fact, resisted without fusion the very highest degree of heat brought to bear upon it, and what that degree of heat is I can hardly estimate, it is so enormous.

But carbon has been found so difficult to deal with on account of its ready combustibility (and some other troublesome properties which I will mention afterward), that experimenters have bestowed much attention upon platinum and iridio platinum as the incandescent material for electric lamps.

Mr. Edison was, I think, the last who attempted to utilize platinum in an electric lamp, and I think there can be no doubt that he obtained better results with platinum, and came nearer making a useful platinum than lamp, any experimenter in the same track who had gone before him.

Here is a view of Edison's platinum lamp.

This is the lamp of which so much was promised and expected in October, 1878, and which led, you remember, to the panic in gas shares. This lamp did not realize the hopes of the inventor.

(I will not rekindle Mr. Crompton's electric sun, because I hope presently to show you some small lamps, whose light would be absolutely drowned in that fierce radiance, as stars are by the light of day.)

While Mr. Edison was endeavoring to produce a useful incandescent lamp by means of platinum, I was endeavoring to obtain the same end by means of carbon.

It had appeared to me for many years that if ever electric light was to become generally useful, it would, most probably, be by means of the incandescence of carbon. I had,

* Abstract of a lecture delivered by J. W. Swan, at the Literary and Philosophical Society, Newcastle-on-Tyne, October 20, 1880.

long before the time to which I am referring, attempted to render this idea practicable.

As a matter of history, I will briefly describe an experiment which I tried about twenty years ago.

I had a number of pieces of paper and card of various forms and sizes buried in charcoal in a crucible. This crucible I sent to be heated white hot in one of the pottery kilns belonging to Mr. Wallace, of Forth Banks. From the pieces of carbonized card which I thus obtained, I selected a long spiral; the ends of this I clipped between small blocks of carbon carried by uprights, and connected with conducting wires. A small glass shade was cemented over this mounted carbon spiral, and the air was exhausted by means of a very good air pump, lent to me for the purpose of this experiment by the Rev. Robert Green, of Longhorsley. A good vacuum (according to the ideas that then prevailed) having been produced, I applied the wires of my battery (consisting of ten cells of Callan's modification of Grove's battery) with great expectation of a brilliant result; instead of this, there was the most absolute negative presented to me; not a vestige of heat or light appeared in my long ringlet of carbonized paper. It was evident, and I immediately recognized the fact, that the electric current of the strength I was using would not go in sufficient quantity through so long a piece of carbon as I had taken. I therefore repeated the experiment with shorter carbon and a greater number of cells, and I obtained, under these altered circumstances, an extremely interesting result.

My carbon was in the form of an arch (this diagram will help my explanation), about one inch high and a quarter of an inch wide. The ends of the arch were held in small clamps, with square blocks of carbon.

The air pump having been worked, I had the pleasure of seeing that when contact with the battery of forty or fifty cells was completed my carbonized paper arch became red hot, and it was evident that nothing more was wanted than a still stronger current to make it give out a brilliant light; but I had used up all the battery power at my disposal, and having reached this limit, I contented myself with watching the behavior of the arch, the engrossing question being—How long will it endure?

I noticed that the inner part of the arch was hotter than the outer part, and that, perhaps in consequence of this, the arch became bent on one side. This bending gradually increased, until at last the arch had so far curled down that the top was on a level with the clamps, and on coming in contact with the sole of the lamp it broke in two, and the experiment collapsed.

That, I confidently believe, was the very first instance in which carbonized paper was ever used in the construction of an incandescent electric lamp.

I am now speaking of 20 years ago, and at that time the voltaic battery was the cheapest source of electricity known, and the means of producing high vacua were very much less perfect than they are now.

I laid my electric light experiments aside until about three years ago, when two things concurred to lead me to pursue the subject afresh.

The discovery of the dynamo-electric machine had entirely altered the position of the question of electric lighting, shifting it out of the region of things scientifically interesting into that of things practically useful.

The Sprengel air pump, too, had been invented, and with its invention we had been provided with a means of producing much higher vacua than could be produced by the old form of air pump.

Mr. Crookes' radiometer experiments had shown us what a really high vacuum was, and how to produce it.

Mr. Stearn, of Birkenhead, an ardent scientific amateur, was so attracted by the extraordinary results Mr. Crookes had obtained by means of high vacua as to go with great enthusiasm into the same line of experiment, and he soon acquired such a knowledge of the Sprengel pump, and such expertness in its manipulation, as perhaps was only equaled by Mr. Crookes himself.

I had the good fortune to make Mr. Stearn's acquaintance, and that was the other one of the determining causes of my second attempt to solve the problem of electric lighting by the incandescence of carbon.

In the interval between the first and second periods I have mentioned many attempts had been made by various experimenters to render practicable incandescent carbon lamps, but none were entirely successful.

Here is represented a variety of the most notable of these attempts. Some are vacuum lamps, and some have air admitted. Sawyer and Mann's lamp is filled with nitrogen. When the incandescent carbon is in air it burns away, and must consequently be renewed just as a candle must be renewed; it must also be thicker than would be necessary in a vacuum, and, being thicker, it requires a proportionally greater current to render it incandescent; both these circumstances are obviously against economy.

(*To be continued.*)

A NEW RELAY.

The relay, a drawing of which is given below, is the invention of Mr. C. C. Vyle, of the Postal Telegraph Department, London, and is really an adaptation of the principle used by Professor Hughes in the electro-magnet of his type-printer, though we believe the inventor was not aware of this fact for some time after his idea had taken practical shape.

In its appearance and build it is certainly not suggestive of the great delicacy which it undoubtedly possesses, as proved by exhaustive comparative trials with post office standard relays, and in actual working upon some of the longest and busiest circuits in the United Kingdom.

With slight alterations in the adjustments it is also claimed to work well as a direct double current sounder, and satisfactorily so in all weathers.

The general construction is as follows:

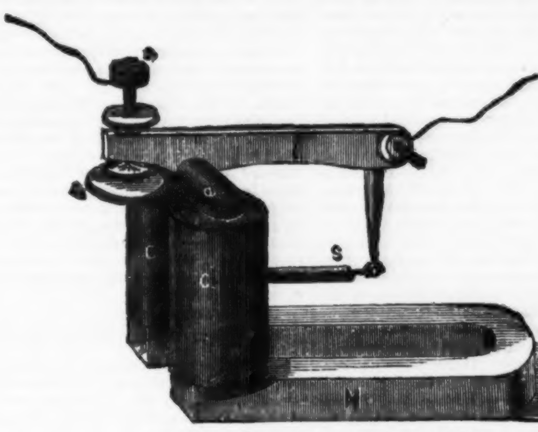
An ordinary horseshoe magnet, M, is laid horizontally beneath the base of the instrument, each leg of the magnet being fitted with a cylindrical soft iron continuation which rises perpendicularly through the base and goes to form the cores of the electro-magnet, C, C. The coils of the electro-magnet are wound differently to 200 ohms each, and may, therefore, be worked singly or duplex. At one end of the lever, *l* (which works in jeweled bearings), and immediately over the cores, is fixed a soft iron armature, *a*, which is attracted by the induced magnetism of the cores.

Toward the opposite end of the lever is attached a spiral spring, S, and adjusting screw, by means of which the force of the magnetized cores over the soft iron armature may be varied or counteracted as circumstances may require. Still nearer this end of the lever are the limiting stops, S_1, S_2, insulated in the usual way.

The most delicate adjustment of the relay is said to be arrived at when the tension spring just balances the attraction of the cores and the lever lies indifferently in either position, and when the limiting stops are just sufficiently apart to break contact and prevent ill effects from the spark from the local battery.

For sounding purposes, the stops, of course, require opening out considerably.

From the foregoing it will readily be understood that if a current be sent through the coils tending to strengthen the polarity already induced in the cores by the permanent magnet, the soft iron armature will be drawn to or retained upon the cores against the tension of the spring; if, however, the current should be in such a direction as to tend to neutralize the existing polarity, then the attractive power



IMPROVED TELEGRAPH RELAY.

will be lessened and the spring will do its work by drawing up the lever to the top stop.

The relay, when well made and well adjusted, will give good signals with one Daniell cell working through a resistance of 10,000 ohms, and if the latter be all removed the relay will still respond properly without requiring to be readjusted; this is a great point.

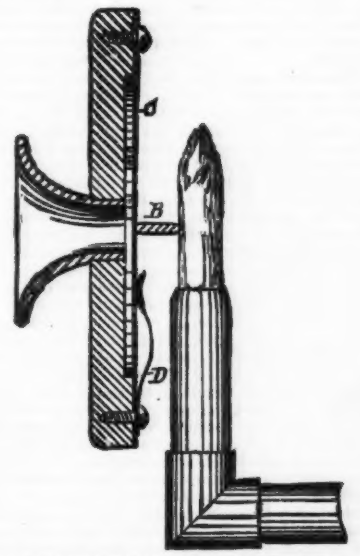
Although Mr. Vyle may not have discovered any new principle in his relay, yet he has certainly shown that there are still some old ones to be worked out.—*Telegraphic Journal.*

PHOTOPHONIC TRANSMITTER.

By Emile Berliner, of Boston, Mass.

This improvement relates to that kind of instruments called "photophones," in which a beam of light is set into vibration by being reflected from a vibratory reflector, or in which the amount of light transmitted at each sound vibration is regulated by the movement of a diaphragm or other vibratory medium.

In my improvement I make use of a heat flame of low luminous quality—as, for instance, the flame of a Bunsen burner, or of an oxyhydrogen light, which is hardly visible, but which may heat other substances brought into its reach to incandescence, so that they become luminous, and to an extent as they are brought into contact with the flame, and I arrange a pencil of platinum, calcium, asbestos, or similar refractory substance so that its point is just in contact with



PHOTOPHONIC TRANSMITTER.

the said flame, and I vibrate this pencil by means of a diaphragm, to which it is secured, or by which it may be acted upon. By this means I bring more or less of the pencil in contact with the flame, and the light emitted by the pencil will therefore in strength be proportionate to the amplitude of each vibration, and light waves, varying in intensity and number in proportion to the transmitted sound waves and their intensity, will result from this manipulation.

In the drawing, A is a heat flame of low luminous quality—as, for instance—a Bunsen flame or an oxyhydrogen light. B is a pencil of platinum, calcium, asbestos, or similar refractory substance, with its point just in contact with the flame. The pencil is attached to the center of a diaphragm, C, suitably mounted and provided with a mouthpiece like the mouthpiece of an ordinary Bell telephone, and this diaphragm may or may not be provided with a damper, D.

By uttering now or producing sound in the neighborhood of the diaphragm the same will vibrate, and the pencil, B, will be brought in more or less contact with the flame, and will give out a light of varying brilliancy, each vibration in accordance with the amplitude of the transmitted sound-wave.

ACTION OF LIGHT UPON COLORING MATTERS.

The members of the Huddersfield Dyers' Scientific Society recently held their first meeting of the session 1880-81, when, accepting an invitation from Mr. D. Dawson, the president, they visited his laboratory at Milnsbridge, where he read a paper on the "Action of Light," and illustrated it by some novel experiments showing the effect of light upon such coloring matters as magenta, chrysodine, and aniline black. In commencing his paper Mr. Dawson said "he thought it might be of interest to make a few remarks on the action of light on bodies. If the subject were reversed and stated in this manner—the action of bodies upon light—we should be landed upon a subject so full of intricacies and difficulties, that I should be totally unable to explain to you the many phenomena which it would involve. I only just need to mention some of these phenomena to make plain what I mean, viz., transmission of light through transparent substances, reflection from bright surfaces, refraction, decomposition, and polarization of light, which all belong to the province of optics. Now, the action of light upon bodies has quite another meaning. By it we mean its power to aid in the building up or decomposition of matter; in short, its power to act chemically. In the vegetable kingdom we see being built up vegetable forms on a stupendous scale, and this process of construction is in some occult way dependent on solar light and heat, the relative importance of which is not very clear. It is, however, well established that vegetation cannot flourish without light. Now what is the general chemical effect in all these natural constructive operations in which light plays an important part? Chemistry demonstrates that it is one of fixation of carbon, hydrogen, and nitrogen chiefly. Compounds of those are taken as the crude building materials, and are broken up in the constructive process, and the elements fixed in the edifice, so to speak, in the form of other compounds of very complex characters. Indeed, so complex are the natural organic compounds, that only in comparatively rare instances had the chemist been able synthetically to construct them, notwithstanding the vast feats of synthesis which have been performed since a more accurate insight into the constitution of bodies has been gained. These crude building materials of nature, viz., carbonic acid, water, and ammonia, require for their breaking up a most stupendous chemical force ere their carbon, hydrogen, and nitrogen are fixed in the plant in the form of other combinations. To illustrate the force required for this work, which is apparent at once to one acquainted with thermal chemistry, let us take, for example, the most abundant material required in building up all organisms, viz., carbonic acid, and try to form some idea of the force which binds together the two elements in this compound. If we take a great many of the metallic oxides, and submit them to the most violent treatment out of contact with other reagents, such is the tenacity with which the oxygen and metal are held together, that they undergo no change whatever; but if heated in presence of carbonic oxide, then they are robbed of their oxygen easily, the carbon having a still stronger affinity for oxygen than the metals themselves. Most of the metallurgical operations in which metals are extracted from their ores are based upon this strong affinity of carbon for oxygen; and yet strong as this is, it is split up easily under the threefold influence of vitality and light and heat. During the process of growth of a plant the carbon is fixed in its structure, and part of the oxygen is sent back into the atmosphere. Now, it is strictly according to law that the force absorbed in bringing about chemical changes, whether direct or indirect, the same force will be given off in the contrary process of restoring the matter to its original form. Therefore when we burn organic matter, let us say wood, coal, etc., the heat given off represents exactly that absorbed during its growth, for the matter in combustion is returned to the same state in which it existed when the plant seized it as nourishment. This fact again furnishes an excellent idea of the forces which operate in these natural phenomena. It has somewhere been stated by a writer that to-day we are running our steam engines with solar light and heat which has been bottled up for us in the earth for millions of years. This is absolutely true. After these few remarks on the action of light in the natural world, which goes on quite independently of man's inventions and operations, and indeed went on long before man existed, let us consider what little use, as yet, man has made of this subtle, yet powerful agent. The most conspicuous application of light to the purpose of art is in photography. Nothing in the whole range of applications of the natural forces to the purposes of art can excel the results obtained by photography for exquisite accuracy. Let us illustrate this by taking a photograph; and at the same time I will endeavor to explain briefly the process. Here is a solution of gun cotton in ether. This solution is called by photographers collodion. I take one of these plates and pour this solution over it in such a manner that it flows as quickly as possible over the whole surface of the plate, and the excess is allowed to drip off at one corner back into the bottle, during which the plate must be tilted to and fro, so as to avoid the formation of streaks. The

production of a uniform film on the plate is a point of great importance. As ether is a substance extremely volatile, it quickly evaporates and leaves the gun cotton as a tough film adhering firmly to the plate. Now besides gun cotton there is also a small quantity of iodide of potassium dissolved in the collodion, so that this substance will also be left on evaporation of the ether thoroughly incorporated with the film. This being done, the plate is next immersed in a bath of nitrate of silver. The merest tyro in chemistry will now be able to explain what will take place between the iodide of potassium and nitrate of silver. The elements simply transpose themselves so as to form iodide of silver, which remains on the plate, and nitrate of potassium, which washes into the bath. While this plate steeps a few moments in the bath, so as to insure a complete reaction between the substances, we will just focus an object in the camera. You see here an inverted image of the object on the ground glass. Now I will bring the prepared plate in a dark slide, which is designed to protect it from exposure to light during its passage to and from the camera. I place the slide in the camera, and the plate which it contains is now in the exact place where the image was seen on the ground glass. I now draw out the door, and allow light to fall upon it. A few seconds is sufficient in good light, and the action has now taken place. The parts which have been exposed to light from the object have been affected, while those kept dark remain unaffected. The exposed and unexposed parts have now different chemical properties, as is proved by the treatment which I am about to submit the plate to, which consists in the first place in pouring on it in the dark room a solution of sulphate of iron, when we see in those parts which have been exposed to light a rapid reduction of the silver compound to the metallic state. After washing away the excess of sulphate of iron, a solution of cyanide of potassium is then poured over the plate, leaving the silver as the paint, so to speak, of the picture. Here is the picture. Although not perfect in a photographic point of view, it has nevertheless illustrated my point; that is to say, the action of light on bodies. But, as might be supposed, the action of light is not by any means restricted to silver compounds. Indeed, in the photographic art itself, which at one time knew only of silver compounds as light alterable substances, there has been in recent times other substances introduced in substitution of silver compounds. For instance, in the carbon printing process, whereby enlargements to very large sizes can be obtained, chromic acid is the light alterable substance employed. Now, as dyers, in whose hands this substance, as bichromate of potassium, is so largely and often found, I deem it well worth your while to pay attention to this peculiar property of chromic acid, as in some cases it may have some bearing upon your art. I will just mention one fact to show you why I think so. At one time I made many attempts to fix aniline black on cloth, and I succeeded to that extent that I think it might be usefully adopted in cases where the shade would be suitable. My first process was to work the cloth in a somewhat strong bichrome black, acidulated with sulphuric acid. One bright summer's day, some of the cloth which had been chromed as indicated was thrown up out of doors. After a time I found the light had acted upon it powerfully, the exposed parts having darkened considerably. Now here was an observation which was destined to prove the nature of the change which the chromic acid had undergone, for my next operation proved that there had been a reduction of the chromic acid, because those parts which the sun's rays had acted upon did not develop the aniline black to the same extent. It is obvious the chromic acid had yielded some of its oxygen. The photographer and the dyer stand, in respect to the influence of light on their respective arts, in quite dissimilar positions. The photographer makes use of light as a constructive agent; it is his main agent to obtain the results desired. Now the dyer has to consider the action of light in quite a different aspect. Instead of serving him as it does the photographer—as an aid to obtain the results aimed at—he regards light as the great destroyer of his work. Indeed, light in one sense, while being the friend and ally of the photographer, is the great enemy to the colors fixed by the dyer. No less on this account should the dyer make himself acquainted with its power of attacking his work; for it is one of the chief duties of a general to study the forces which can militate against him, in order that he may bring a superior force to successfully combat the enemy. The dyer, then, has to form a proper estimate of the attacking force of light upon his colors. This can only be done by actual experiment, by exposing them under proper conditions. Throughout the whole range of coloring matters used by the dyer we find a very wide series of gradations in respect to resistance of the decomposing action of light; some colors being attacked in a few hours, while others can withstand its action as many years. This is known not only to dyers, but generally, hence we have the common expression: 'Don't have that color, because it fades.' But since the introduction of such a great variety of new coloring matters into the art, the public will be puzzled in forming a judgment as to the fugitiveness or permanency of certain shades, and they will often be quite wrong in their conclusions; for the same shade will many times vary in regard to fastness, because it is often produced by the use of totally different coloring matters, each having its own specific power to resist the action of light. But the dyer should be so well acquainted with all colors in respect to light resistance, that he may select the most suitable for special purposes. Where it is of the utmost importance that a permanent color should be used, then of course he must have recourse to one of that class, although in other respects it might be disadvantageous. For instance, it might lack the desired brilliancy, facility of fixing itself to the fiber, or be somewhat detrimental to the material. Although the resource of coloring matters is now so rich, chiefly by the addition of new coloring matters obtained by comparatively recent researches, the dyer is yet compelled in a host of cases to use fugitive colors where more permanent ones would be far better, because the circumstances in the dyeing operations and the properties of the colors are such that there is sometimes but little choice left as to which must be used. Those circumstances have to be met, even if the color selected be somewhat fugitive. For instance, how many colors are all that could be desired as regards woolen dyeing? But when it is a question of bringing cotton up to the same shade in the same fabric, the dyer has to hunt for another color to accomplish the end, and he often fails to find one in which are combined all the properties required for the purpose. Well, then, he has only to do his best, and the public will have to be satisfied with the best attainable. The requirements of fashion are so great that it is no wonder the dyer still lacks the means of completely meeting them satisfactorily. But perhaps on this very account the art is more interesting, as it furnishes a field for constant experiment with a view to remove ever-recurring difficulties; and, with the aid of the chemist, the dyer has from time to time removed many obstacles, which seemed almost insurmountable. Let us hope, then, by perseverence and application he will always be able to cope with them. The technical schools which are springing up around us, combined with more extended scientific knowledge, will give him immense assistance in his attempts to find new applications for coloring matters, or improved methods of using them. I have now an observation to lay before you which further illustrates the action of light. I have mentioned the alteration of chromic acid in cloth by the influence of the sun's rays. I think I established the fact that the alteration was due to the reduction of chromic acid. Now it occurred to me that if chromic acid is rendered more deoxidizable under the influence of strong sunlight, or, what is the same thing, becomes a more powerful oxidizer, it might be made to act upon matters which are capable by oxidation of developing a coloring matter, at an accelerated rate, with the assistance of solar light. That the rate of action is so accelerated I will show you a plain proof. It is evident that this accelerated action furnishes the elements for taking a photograph. Here are several formed by the fixation of aniline black on paper by the aid of sun light. I have now only to show you three colors which I have exposed about fourteen days. I have exposed them in a novel manner. I have placed them under a photographic negative. I have selected two of the most fugitive colors, viz., magenta and crysoidine; the other is an azo compound, and far more permanent. You observe the magenta and crysoidine have given photographs, although very indistinct, while the azo compound has not yielded to the action of light."

MANUFACTURE OF SALTS OF SODA.

VARIOUS forms of apparatus have been constructed for applying the reaction of carbonate of ammonia upon chloride of sodium to the manufacture of salts of soda. The processes at present in use fail, however, to give sufficiently satisfactory results, and the following method of manufacture is now proposed, and forms the subject of a patent by Count de Montblanc and M. Gaulard, of Paris. The process is divided into two parts: 1st, the solution of the chloride of sodium and saturation of this solution with ammonia; and, 2d, the saturation of the mixture thus obtained with carbonic acid, which saturation determines the formation of bicarbonate of soda which is insoluble in presence of the whole hydrochlorate of ammonia. The apparatus for effecting the first of these operations is arranged as follows: The chloride of sodium is introduced into a vessel of sheet iron, into which an inverted tube allows of the introduction of water at its bottom, the passage of the water into the vessel being regulated by a cock provided with a float, to be hereafter described. The vessel is placed in a larger vessel of sheet-iron or of wood, which is in permanent communication, by means of upper and lower pipes, with a third vessel of the same height and placed in the same horizontal plane. Under these conditions, the solution of chloride of sodium under operation in the first vessel will overflow and take the same level in the other vessels. When this level reaches the upper communicating-pipe, the float, acting automatically, stops the entrance of the water by the immersed tube. By means of a cock fitted to the third vessel the solution of chloride of sodium is introduced by an immersed tube into a receiver. This receiver is cylindrical, and is made of sheet-iron; it is divided horizontally by partitions provided with small communicating tubes or passages placed alternately to the right and left of the apparatus; at its upper part are a pressure-gauge and a cock. There is a tube at the side of the apparatus to empty the saturated solution into the feeding-vessel of the precipitating apparatus to be presently described. A column at the side allows by means of a cock all the compartments to be put in direct communication with each other. The whole of the apparatus can be immersed in a tank filled with cold water, which permits the heat developed in the formation of the ammoniacal sodic solution to be absorbed. The ammoniacal gas is introduced by a rose, and saturates the solution of chloride of sodium contained between the bottom of the apparatus and the first partition, then, exerting pressure until the level of the liquid falls below the communicating tube, it passes out by this latter and saturates the liquid contained in the partition next above, and so on, until—the last layer of liquid having been saturated—the gas exerts its pressure upon the gauge and indicates that the operation is finished. We will now describe the arrangement of apparatus in which are effected the saturation with carbonic acid and consequently the precipitation of the bicarbonate of soda: The several parts of the apparatus which communicate with each other, so that they can be taken successively in order, are alike. They comprise a cast-iron cylinder, in which is a hollow central shaft of cast or wrought iron, provided at its bottom with beaters or agitators capable of being driven by bevel-gearing. This hollow shaft, which has holes at its bottom, admits a current of carbonic acid regulated by a cock. An immersed tube provided with a cock allows of the communication of the apparatus with the feeding vessel which contains the mixture prepared in the apparatus first described. Cocks placed upon the pipe for distributing the carbonic acid allow of the direct introduction of this gas successively into each apparatus. There are manholes for removing the bicarbonate of soda. The several parts of the apparatus are in communication one with another by a tube; this communication is permitted by cocks, from the upper or the lower portion of the apparatus, according to the requirements of the operation. There are movable gratings or strainers to prevent the passage through these cocks of anything but the liquid portion of the product of one apparatus into that next following. The action in the first apparatus of the series is as follows: The cock communicating between the lower part and the second apparatus is closed. The cock at the top of the hollow shaft and that communicating between the upper part and the second apparatus are open. The liquid mixture of chloride of sodium and ammonia and the carbonic acid gas enter the apparatus simultaneously. The precipitation of the bicarbonate of soda takes place, and the shaft being put in motion, the precipitated salt is thrown against the sides of the apparatus, and cannot obstruct the holes by which the carbonic acid gas is introduced. The level of the liquid will rise to the upper cock, by which it will run into the second apparatus, while the non-utilized gas, drawing away a certain quantity of ammonia, acts while passing through an opening at the top upon the incompletely decomposed liquid. The two elements, gas and liquid, thus pass successively into the second and following apparatus; it will be understood that the liquid collected in a pipe leading from the lower part of the apparatus will be pure hydro-chlorate of ammonia, and that the gas escaping will not contain either free carbonic acid or trans-ammoniacals. When the apparatus No. 1 is sufficiently charged with bicarbonate of soda, the requisite cocks are closed and the cock at the lower part is opened; in consequence of the pressure exerted by the carbonic acid gas, the liquid only of No. 1 apparatus is emptied into No. 2 apparatus; the lower cock is then closed, and a cock is opened to admit the carbonic acid gas directly into No. 2 apparatus, which now takes the place of No. 1. The manhole of the first apparatus can then be opened, and the bicarbonate of soda removed. This operation being finished, this apparatus then becomes the last of the series. It will thus be seen that this arrangement allows of the continuous saturation of the ammoniacal sodic liquor. By preventing the drawing off by the non-utilized gases of a portion of the ammonia, or even of the carbonate of ammonia, the manufacture can be continued without interruption.

ARTIFICIAL CITRIC ACID.

IT is announced in the *Comptes Rendus* that Messrs. Grimaux & Adam have succeeded in the synthetical production of citric acid from glycerine. They started on the theory that glycerine was a trihydroxy-propane ($C_3H_5(OH)_3$), and that citric acid was a similar compound, but with two hydroxyl groups, and one hydrogen atom replaced by the group CO_2H (carbrosyl), making of citric acid a hydroxy-propane-tricarboxyllic acid, thus $C_3H_4(OH)(CO_2H)_3$. This theory their experiments have demonstrated to be correct. They first, by means of hydrochloric acid, replace two atoms of hydrogen of glycerine by chlorine, and produce dichlorhydrine ($CH_2ClCHOHCH_2Cl$). Oxidizing this they get dichloracetone. They combine this with concentrated prussic acid and get a cyanine, which they then convert by hydrochloric acid into dichloracetonic acid. By distillation and extraction with ether they get this acid in crystalline form. Then they make a soda salt with it, and treat with potassic cyanide, when the chlorine changes place with the cyanogen, and yields potassic chloride and dicyanacetonic acid. This substance, as expected, proved to be a *nitrile*, *i. e.*, a substance which by saponification with potash yields an acid, or rather its potash salt. The acid thus obtained is identical in every respect with that obtained from lemons; in fact, is really citric acid. Whether this discovery will ever lead to a practical commercial result cannot yet be predicted, but no doubt its accomplishment is to be regarded as a great triumph in the uncertain domain of organic chemistry. It appears that Kekulé has also been working on this subject, and in the last number of the Berlin *Berichte* he feels justified in saying that very probably the process adopted by him has resulted in the formation of citric acid.

DOCTORED WINES.

THE French Government have just passed a most salutary measure, which will have for effect the diminution, if not the complete suppression, of the process known as *plâtrage*, now become an almost constant custom through most of the wine districts of France, and which, from having at first been performed on a very moderate scale, has lately enormously increased, till it has developed into a crying abuse. The *plâtrage* is carried on during the fermentation, and consists in merely sprinkling the grapes, as successive baskets of them are emptied into the fermentation vats, with plaster of Paris—calcium sulphate—(French *plâtre*), mineralogically known as gypsum, or selenite, in fine powder. Now the grape-juice contains several salts of potash, among which the most abundant are the tartrate and bitartrate, and these decompose when placed in contact with the calcium sulphate, forming calcium tartrate—an insoluble salt—and potassium sulphate.

In the case of potassium bitartrate, potassium bisulphate is formed. Now, besides the salts of potash above named, the juice of the grape contains grape sugar, a nitrogenous fermenting principle and an astringent principle—to which latter new red wines owe much of their harshness—and also a red coloring matter, with which the astringent principle is intimately associated. The fermentation splits up the grape-sugar, as it is well known, into carbonic acid, which escapes with effervescence, and alcohol, which remains dissolved. In pure undoctored wines, in proportion to the development of alcoholic strength, and as the wine by age tends to become more acid, potassium bitartrate separates as a crystalline precipitate, forming the chief constituent of the deposit in the casks known as *lees*, or, when it forms in bottled wines, as the *crust*.

Now, the astringent principle which in the red grape is, as we have explained, intimately combined with the coloring-matter, seems to be held more or less in solution by the tartrates, and as these subside with age the wine grows less harsh, losing at the same time much of its color, and is said to ripen or grow mellow. As the astringent principle, however, disappears, the wine, if it be one of the weaker French wines, tends to run to the acetous fermentation, and this is why we frequently find a wine become sour and unpalatable shortly after it has mellowed with age and arrived at its maximum of perfection. Many a bin of valuable claret or Burgundy has thus suddenly surprised and disappointed its possessor, changing in the short space of a few months from fine mellow wine to undrinkable vinegar.

Now, as stated above, calcium sulphate (*plâtre*) decomposes the potassium tartrates, and by withdrawing them and substituting the potassium sulphate, tends to prevent much of the coloring and astringent matter from passing into solution, so that this so-called *plâtrage* is nothing more than a means employed by the Bordelais and Burgundians for giving to their wines a fictitious effect of age, and they naturally defend a practice which enables them to bring their wines sooner into the market, economizing their outlay in casks, and diminishing the chances of loss entailed by keeping a large stock of wine on hand. Further, the process lends itself to fraud, permitting the wine merchants of Bordeaux and Burgundy to import the strong harsh wines of the north of Spain and the southeast of France, which, when blended with the small, poorer wines of the hill-districts of their own country, and then being *plâtrés* (that is, agitated with powdered calcium sulphate), become mild and palatable. Thousands of hogsheads of wines thus blended and doctored are annually sold, and too often at the high rates commanded by pure vintage wines. Under the provisions of the new act no wine is allowed to be brought into commerce if it contains over two grammes of potassium sulphate per liter. Even this proportion is too large, *plâtrage* should be entirely prohibited; but when we consider that wines are now often sold with five or six grammes of this salt to the liter, it was time indeed that some measures should be taken. The merchants defend themselves on the basis of the practice being innocuous, and that while it promotes the keeping qualities of the wine, even four grammes of potassium sul-

phate could do no harm. It is the greatest possible mistake to fancy that *plâtrage* makes wine keep; for on the contrary, it withdraws from it the astringent principle, a most potent means of its preservation. For a Bordeaux merchant to contend that forty grains of potassium sulphate to the pint of wine is not or cannot be unwholesome, is a thesis which may be agreeable to his pocket, but certainly ought to be discouraged, for, to say the least, it would surely be prejudicial to the stomachs of delicate or dyspeptic consumers. Not very many years since a case occurred of actual death by poisoning from the administration of a comparatively small dose of potassium sulphate, and this salt is well known in medicine as a drastic and dangerous purgative. We should then be most sincerely grateful to the French Minister of Commerce for the prudent forethought with which he has protected the consumers of French wines from a practice which had grown into a crying abuse, and for giving us one more guarantee for the purity of the sewines, justly ranked as the most esteemed that the world produces.—*Nature.*

BREAD COLORED BLUE BY RHINANTHIN.

C. HARTWICH, apotheker in Tangermünde, has recently met with an interesting impurity in bread, which he describes in the "Archiv der Pharmacie," vol. ccxvii., p. 289. A miller brought him a sample of bread, intense violet in color, and with samples of meal and rye of which the bread had been made. The rye was quite normal; but besides a few grains of ergot, it contained the seeds of *Vicia hirsuta, Agrostemma githago, Sherardia arvensis, Raphanus raphanistrum, Centaurea cyanus, Avena sp., Polygonum sp., Melampyrum arvense*, amounting together to 3·71 per cent. The seeds of the *Melampyrum*, or cow-wheat, formed nearly half the impurity, or 1·59 per cent. of the whole.

The violet color in bread had been noticed more than once in the "Archiv" (October, 1868; June, 1870; August, 1871; January, 1872); and reference to these papers, and to Husemann's "Pflanzenstoffe" (p. 911), showed at once that the coloration was produced by the rhinanthin present in the seeds of the cow-wheat.

This was confirmed by the making an alcoholic extract of the bread, the meal, and the seeds of the cow-wheat, which took an intense green when boiled with hydrochloric acid, especially on cooling, and a bluish tint when boiled with sulphuric acid. The reaction with hydrochloric acid is quite distinct when the meal contains one-twelfth per cent. of cow-wheat, but the baking (not the fermentation) of the bread was found to destroy part of the rhinanthin. As this glucoside had been found in *Melampyrum arvense* and *Rhinanthus hirsutus*, both belonging to the sharply-defined group Euphrasiæ, the species of which have so many characters in common, the author looked for it in the seeds of other members of the group which grew in his neighborhood. He found that the hydrochloric acid and alcoholic reaction was given by the seeds of the following plants: *Alectorolophus (Rhinanthus) major, A. minor, Melampyrum cristatum, Euphrasia odontites, Pedicularis palustris, Bartsia alpina. Euphrasia officinalis* gave a modified reaction, and *Pedicularis silvatica* gave none.

OIL OF COFFEE.*

DR. C. O. CECH, of St Petersburg, has examined the chemical nature of the products obtained by roasting coffee. The presence of a volatile oil in coffee is at once noticed when coffee is roasted by the delicate aroma given off, and in strong infusions of coffee the oil is seen swimming on the surface of the liquid In the large coffee-roasting works of Germany and France, where several tons of coffee are daily roasted, the quantity of volatile oil which escapes is so considerable as to make it worth while to collect it. Coffee beans contain from 8 to 13 per cent. of volatile oil, one half of which is lost by roasting. The author, therefore, tried to combine the roasters with a condenser, so as to collect the escaping oil; but, owing to the fact that at the point when the beans have got thoroughly brown and begin to give off vapors, it is absolutely necessary to at once remove them from the fire, it was not possible to condense the escaping oil The author has, however, no doubt that by means of a proper exhausting contrivance the object could be attained. When the beans are removed from the fire they are cooled as quickly as possible, so as to prevent their taking fire. The cooling is effected by shaking them in the air, and in large coffee-roasting works the walls literally trickle with oil of coffee. When, therefore, a suitable apparatus has been devised for collecting this waste oil which contains all the flavor of coffee, and would form an excellent material for liqueurs, a great saving to coffee-roasters would be effected. The amount of coffee roasted in 1878 the author estimated at 490,840,000 kilos, or about 123,000 tons.

A DESTRUCTIVE FIRE CAUSED BY SULPHURIC ETHER.

ABOUT noon, November 20, a fire began in the third story of the large wholesale drug house of Lord, Stoutenburgh & Co., Nos. 73 and 71 Wabash avenue, and continued to extend, despite the efforts of the fire department, until the entire double building, with its contents, was destroyed. In the basement, which was filled with water, which soon froze, owing to the intensely cold weather, are a few articles of value, which may yet be recovered. A lot of druggists' sundries on the main floor were also saved, in a somewhat damaged condition. The total loss will exceed the small amount of salvage by probably one hundred and fifty thousand dollars. The insurance is one hundred and thirty thousand dollars, ample to enable the firm to resume at once in a vigorous condition.

The cause of the fire is the old stereotyped one in the drug business, the ignition of sulphuric ether. A girl in the third story, which was used as a pharmaceutical laboratory and general "wet room," was bottling a quantity of sulphuric ether and sealing the bottles with wax melted by an alcoholic lamp, when, upon forcing in a cork, the bottle broke, scattering its contents upon her and in the vicinity of the lamp. In an instant the spilled liquid was in flames, and a moment later the entire lot added fuel to the fierce fire. Another girl near the scene was enveloped in the flames. One of these ladies, Miss Anderson, is now dead, and the other lies in a critical and suffering condition. The gentlemen in this room did their best to rescue the girls and subdue the fire and in their devoted efforts suffered fearful burns, with only the success of bringing out the girls alive.

Notwithstanding the frequent disasters resulting from the ignition of ether, few seem to realize its dangerous nature. Dr. Squibb nearly lost his life and wholly lost his beauty by an accident almost exactly identical with this. Gordon's laboratory was once destroyed by the explosion of the vapor of ether, although the still in which it was being made was over thirty feet from the nearest fire. The heavy vapor had formed a stratum near the floor, unnoticed by the men until it extended to the fire of the boiler furnace, when the explosion occurred, the flame running to the still as if aided by a large train of gunpowder.—*Chicago Pharmacist.*

* *Journal für practische Chemie*, October 18, 1880.

CHLOROPHENOLS.

IN the *Journal für practische Chemie* Dr. C. O. Cech points out the advantage of using chlorophenol instead of phenol in dressing wounds in a state of suppuration. It has been constantly noticed that wounds treated with carbolic acid alone do not heal so quickly as when a mixture of carbolic acid and chloride of lime is employed, and M. P. Diamin found that when carbolic acid and chloride of lime were brought together a chemical change takes place, mono, di, and trichlorophenol being formed, and that from the resulting lime and chlorophenol mixture the chlorophenols can be separated out by adding some strong acid, and by distilling with water. The author does not consider this method practically available. The best and cheapest way of getting a mixture of chlorophenols suitable for dressing wounds he found to consist in decomposing carbolic acid with chlorine gas, a somewhat expensive method, but at present the best known. The price of such a chlorophenol is at present 5s. per lb. The chlorophenol mixture contains all three chlorophenols, but consists essentially of trichlorophenol, which latter is the chief disinfecting agent. The chlorophenol mixture is a blood-red crystalline mass of a peculiar penetrating odor and bitter taste. It is easily soluble in alcohol and ether, and is, in its topical effects, far less cauterizing than carbolic acid. By repeatedly pressing the red crystalline magma between blotting-paper, and crystallizing from ether, dazzling white prismatic needles are obtained, which, upon adding water to their alcoholic solution, precipitate in flocks. This precipitate is dissolved in alcohol, and the bandages impregnated with the solution. The author thinks that trichlorophenol will ultimately supersede carbolic acid in dressing wounds, and as an antiseptic agent.

PRECIPITATION OF MANGANESE HYDRATE BY AMMONIA.

By GIULIO PULITI.

THE author first examines the influence of ammoniacal salts in particular, and of ammonium chloride in particular. He finds that the precipitation of manganese from its solutions by means of ammonia may be partially or totally hindered by sal ammoniac. Heat renders the sal ammoniac more efficacious. In hot liquids the precipitation of manganese may be completely prevented if the metal meets with this reagent in the proportion of 1:150. He next examines the action of the metals which are capable of precipitation as hydrates by means of ammonia. He finds that iron, aluminum, and chrome facilitate the precipitation of manganese.

GELATINE.

THE use of gelatine for photographic purposes has increased to such an extent that, from being a comparatively obscure and unknown organic substance, it has arisen to a position of some prominence among photographic chemicals; hence it is much to be regretted that, up to the present time, so little has been done toward the manufacture of samples which can be uniformly depended upon. So far, indeed, is this from being the case, that not only is there a wide difference between the samples of different makers, but there can scarcely be found even two samples from the same maker which are absolutely identical. It is even found necessary, in many of the processes for which gelatine is now used, to submit each fresh supply to a chemical examination in order to discover in what way it can be most effectively used.

One cause for this excessive variation in samples of gelatine is no doubt to be found in the fact that the substance extracted by boiling water from animal tissue is not, under all circumstances, of the same chemical composition. Thus, both from the permanent cartilages and from the temporary cartilages prior to ossification, boiling water extracts a substance called chondrin, the composition of which is represented by the formula $C_{16}H_{26}N_2O_7$; but from bones, white fibulous and cellular tissue, and membranes, there is obtained another substance to which the name of glutin has been given, and which has the formula $C_{16}H_{25}N_5O_6$.

The difference in the composition of these two substances is more apparent from the following percentage analysis:

	Chondrin.	Glutin.
Carbon	49·97	50·40
Hydrogen	6·63	6·64
Nitrogen	14·44	18·34
Sulphur	0·38	—
Oxygen	28·58	24·62
	100·00	100·00

The gelatine of commerce, consisting of these two substances, glutin and chondrin, in proportions which continually vary, can scarcely be expected to be of uniform quality, since not only the source whence it is derived, but also the age of the animal, will influence the nature of the resulting product.

Since glutin is much more soluble than chondrin, the solubility of a given sample of gelatine will depend chiefly upon which of these two substances is in excess. When we remember the requirements of the various processes in which gelatine is employed, it is easily understood why a certain kind of gelatine should be more especially adapted to each particular case. For instance, while a gelatine which is rich in chondrin is better suited for collotype work, a glutinous gelatine is found more effective in carbon printing.

Unfortunately, an easy method does not yet exist for the quantitative estimation of the amount of chondrin in a given sample of gelatine, although its presence may be detected, and an approximate conclusion arrived at, by its reactions with alum or with lead acetate; while glutin may be distinguished from chondrin by its behavior with mercuric chloride.

Hence, there is some difficulty in procuring the best proportions of these two substances in the absence of any accurate means of determining their amounts. There is no doubt, however, but that much advantage would result from a suitable admixture of various samples known to be rich in one or the other substance. Of all known commercial gelatines a series may be made, showing a gradual transition from those which are richest in chondrin to those which, like common glue, consist almost entirely of glutin; so that, even with the samples at present existing, it would be possible, by admixture, to procure a gelatine suitable for any required work, were it possible to effect a correct quantitative determination with facility. But in all probability manufacturers will before long find a means of supplying samples which can be depended upon for uniformity of composition.

Solubility, however, is not always the most important circumstance to be considered. For some processes, such as the collotype, it is especially necessary that there should be great consistency or capability of resisting mechanical pressure. Independently of the means of increasing the toughness of gelatine by the addition of alum, this property seems to depend somewhat upon the properties of chondrin and glutin, since all the more glutinous varieties are characterized by a very low degree of consistency. The immense difference exhibited in this respect by the various gelatines of commerce is seen from the fact that, whereas the best samples can withstand a pressure of 1,400 grammes on a gelatinized ten per cent. solution, the worst kinds are crushed by a weight of 50 grammes. Solubility and toughness seem to stand in inverse relations to one another, which is another reason why, for some purposes, better results would probably be obtained by a suitable admixture of various kinds. Important as the above considerations may be in all kinds of photo-mechanical printing, to the ordinary photographer it is of far greater importance that gelatine should be free from impurities. Impurities exist to a greater or less degree in all commercial varieties, and can easily be estimated by a quantitative determination of the ash left after combustion. The amount of this ash varies from 4·5 to about 0·5 per cent. and consists chiefly of carbonate and sulphate of lime, alumina (with traces of silica), phosphoric acid, oxides of magnesium, iron, and of the alkaline metals. The presence of phosphate of lime is so universal that Mulder considers it to be an essential constituent of gelatine. This view seems more probable from the fact that true chemical compounds of gelatine with calcin phosphate can be prepared. But it is sufficient now to know that the process of manufacture necessitates the presence of this substance in gelatine.

The universal presence of these impurities in gelatine would appear to render easier of explanation the necessity for an excess of haloid salt in preparing emulsions with gelatine. Captain Abney has shown that an excess of silver may produce fog, on account of the impurities present in the haloid salt; but this mischief would be greatly increased by certain of the impurities found in gelatine; for instance, the potash proved to be present in the ash of most gelatines would form oxide of silver if the nitrate were in excess.

Commercial gelatines are frequently adulterated with a considerable quantity of alum for the purpose of increasing their toughness and gelatinizing power; but, since as much as ten per cent. must be added for this purpose, its detection is easy, both by the large increase in the amount of ash and by other means.

It is not improbable that the presence of even small quantities of impurities, and especially of potash and soda, exert a remarkable influence on the proneness of gelatine to decompose; for weak solutions of soda and potash dissolve and decompose gelatine, even in the cold, and much more quickly when heated. This might partly account for the fact that, whereas some samples may be boiled with impunity, others cannot be kept long at a high temperature without decomposition setting in.

With the above facts in view, we can no longer express any astonishment at the great differences and apparent contradictions which characterize the methods of workers with gelatine, and which tend both to perplex the tyro as well as to retard the true progress of photography.—*Photographic News.*

COFFEE TREE SACCHARINE MATTERS.

By M. BOUSSINGAULT.

THE author has operated upon 6·4 kilos of alcohol, in which the ripe fruits had been brought over, and 9·080 kilos of fruit taken out of the alcohol. He obtained a total yield of 92 grammes mannite, 364·4 grammes inverted sugar, and 98·6 grammes cane-sugar. He does not consider that the pulp of the coffee berry could be utilized as a source of alcohol.

ANTISEPTIC INFLATION.

MR. J. HOLDEN WEBB, of Melbourne, has recently published a paper in the *Australian Medical Journal* describing and advocating a new plan of rendering old sinuses and putrid abscess cavities aseptic. At first such cases were dealt with by injections of carbolic acid lotion; more recently Volkmann has introduced his sharp spoons, by means of which the unhealthy granulation tissue forming the walls of such passages and cavities can be removed, and inasmuch as there is good ground for believing that septic organisms not only exist in the putrid discharge, but also infest the secreting walls of such cavities, this must be considered, and, indeed, has proved, a valuable adjunct to the simpler plan of injections only. In dealing with very large cavities, irregular and sacculated, such as are particularly met with in connection with disease of the spine, it is obviously very difficult, if not impossible, to inject fluid so thoroughly that it shall penetrate into every corner and exert its germicide property on every part, and in these cases also the use of Volkmann's sharp spoons is necessarily limited within very narrow bounds. It was for such cases that Mr. Webb tried inflation with carbolized air, as being more likely to give success. His apparatus is simple. Into a Florence flask he puts some crystallized phenol, and through the cork, which fits tightly, he passes two glass tubes, one passing to the bottom of the flask, the other only just beyond the cork. These tubes are bent at right angles just above the cork. To the long tube a Richardson bellows is fixed. When in use the flask is raised on a stand, the acid melted and heated by a spirit lamp, and air forced by the bellows through the acid in the flask, and by the shorter tube into the cavity to be inflated. All the force of the hand is used in the inflation, the cavities being tightly distended, and although it "often makes the patient drowsy for some hours afterward, and sometimes renders the urine smoky," Mr. Webb has not met with any ill effects. Thymol inflation has been followed by disagreeable sickness. In his paper cases of old sinuses, spinal and other abscesses, submitted to this treatment are detailed, and it is stated that the results in correcting septicity of discharge, and therefore in checking suppuration, fever, and hectic, and hastening recovery, have been very satisfactory.—*Lancet.*

THE PHARMACEUTICAL EXHIBITION AT BRESLAU.

A VERY interesting feature in connection with the recent meeting of the Deutsche Apotheker-Verein in Breslau was, as in former years, the Pharmaceutical Exhibition. This was held on the premises of the Concert House, in the Gartenstrasse, in which the meetings of the association took place One portion of the exhibits was displayed in a long gallery running along one side of the principal concert room; another portion was shown in three large rooms in the building that were entirely devoted to the purpose; while a third portion was accommodated under a colonnade in the gardens attached to the establishment. Altogether there were about ninety exhibitors.

The display, being this year more scattered, was hardly so effective in appearance as that at Hanover last year. Moreover, two sections which were there well represented—the pharmaceutical apparatus and the archæological literature of pharmacy—were on this occasion much less conspicuous. Neither was any display of microscopes or other similar apparatus noticed; and again, there was a complete abstention on the part of chemical manufacturers. But there were many objects of interest to pharmacists shown, quite sufficient to well repay the trouble involved in a visit, and the exhibition, closely associated as it was in one of its departments with opportunities for the renewal of friendship and the drinking of lager beer, was certainly not the least attractive portion of the meeting.

Perhaps the feature that would first strike an English visitor would be the prominent position assumed in the exhibition by the exhibitors of natural mineral waters and of wines for medical and pharmaceutical uses. Of the mineral waters there were several displays, the largest one being a collective exhibition by five Breslau firms, which included waters from about sixty different springs, and the literature describing their composition and alleged properties formed, when collected, a considerable bundle.

Besides the bottled waters there were a considerable number of products, many of them in the shape of residues, either deposited naturally or obtained artificially by evaporation. Among these were evaporated residues and mother liquors from the Kaiserquelle, Marienbad, Saidschutz, Vichy, Giesshubler, and other springs, some rather crystalline carbonate of magnesia and "pastilles digestives" from Bilin water, and a soap said to contain iodides and bromides made with water from the Goczalkowitz Spring, near Pless. From Franzenbad was shown a ferruginous peat for baths and a ferruginous ocher (hydrated red oxide) for use in gas purification.

The attention given to the wines seemed to indicate that they occupy a more important place in German pharmacy than in English. Tokay was conspicuous, almost suspiciously so, considering the small quantity that is said to cross the Hungarian borders, otherwise than to Russia, where it is almost exclusively consumed. Greek wines also seemed to be in favor. A specialty of Messrs. Duhr & Co., of Cologne, consisted in small bottles of wines, ranging upwards from a few ounces. They also showed a medicinal "champagne," warranted free from added carbonic acid.

In the colonnade were three fine collections of vegetable drugs, exhibited by Herr Grund, of Breslau, Messrs. Wolff & Rasim, of Breslau, and Herr Kathe, of Halle, and it would be difficult to award among these the palm for greatest merit. Herr Grund exhibited cinchona barks in unusual variety, but the specimens were unequal in quality; the Ledgeriana was shown in dark brown, thin, smooth quills. Another notable feature in this display was the gums. One specimen, marked "Gummi arabicum Gezyrrhi," was extremely white and brilliant, and others approached it in beauty of appearance. One specimen, however, bearing the anomalous title "Gummi arabicum australischer," was frankly marked "worthless." Gum benzoin from Siam was there in large and beautiful fragments, and the Sumatra and Palembang varieties in square blocks. This Palembang benzoin, it will be remembered, contains no cinnamic acid; it is now worked for benzoic acid, of which it contains about ten per cent. There were also some fine white tears of olibanum, and some, too, that had a purplish tint. Then there were flores pyrethri rosei and flores chrysanthemi (wild, from Monte Nero and the Herzegovina, and cultivated from Civita Vecchia and Ragusa), and the powders prepared from them. Sarsaparilla from Honduras, Vera Cruz, Guatemala, and the Rio Negro were exhibited in original packages, the latter being in hanks, not unlike in shape to parallel eel pots. There was also an original package of curari, consisting of a tier of five small pots. A large collection of sponges attracted attention by their size and beauty, the African varieties from Mandrucha and Bengaso being especially noticeable. Some of the sponges were of a delicate primrose color, and with respect to the bleached sponges it was stated that they had been treated with permanganate of potash and not with oxalic acid.

The collection of Messrs. Wolff & Rasim included, among other things, some fine specimens of coto and paracoto barks. There were also samples marked "cort. quebracho blanco" and "cort. quebracho colorado," but the former was more fibrous and otherwise differed in appearance from other specimens of the true quebracho blanco bark. The kind presentation by the firm of a sample of this as well as of the red bark to the museum of the society will allow of comparison being made, and perhaps throw some light upon its origin.

Some of the specialties of Herr Kathe were noticed in the account of the exhibition in Hanover last year. Among other noticeable features in this year's exhibition were flores pæoniæ; folia salviæ; folia piperitæ and crispæ, used for making infusion or "tea;" the rhizomes of *Iris tornata*, cut into slices, with a hole in the center, for children; a cake of resina draconis, about eleven inches in diameter and three inches thick; licorice root, cut into flakes, and the rhizome of *Filix mundata*. Herr Kathe also exhibited some large pieces of *Aspidosperma quebracho blanco* bark, one of which was kindly presented to the Museum of the Pharmaceutical Society.

Herr Muller, of Ober-Glogau, limited his display to single chamomile flowers.

The display of pharmaceutical preparations, although not very extensive, was interesting, and some of them were particularly noticeable because of the greater relative importance that they seem to enjoy in Germany as compared with this country. This is especially true of what may be called pharmaceutical confectionery, and of such preparations those of santonin were among the most common, occurring generally in the form of a conical troche, containing a definite quantity (about 0·03 gramme) of santonin. Whether this conspicuousness of santonin is dependent upon, or simply concurrent with, the national consumption of "schinken" and sausage is perhaps fair matter for conjecture. Another preparation that assumed considerable prominence is sal ammoniac in the form of tablets. There were also some very nice-looking samples of licorice extract in thin pipes and in threads. Other articles were malt pastilles and bon-bons, flesh-peptone chocolate, and some good-looking gum pastilles, not coated, but made uniform throughout. As might be expected, Silesia being the home of the beet, some very fine specimens of sugar were shown, both in lumps and as an impalpable powder, and the exhibition by Herr Eulner, of Berlin, of a sugar for pharmaceutical purposes that was warranted to be "free from ultramarine" showed that the importance of such an impurity, as pointed out by Dr. Symes, is thought worthy of recognition.

Capsules were also well represented, and the exhibit of Herr Pohl, of Schonbaum, near Dantzic, was again worthy of special mention, not only on account of the variety, but also for the beauty and elasticity of the capsules and perles. Here were capsules containing in each 0·05 gramme to 0·25 gramme of quinine; others containing 7·5 grammes of castor oil, in neat boxes, each holding four capsules; others were filled with sandal wood oil, or with cod liver oil containing one to three per cent. of iron in the form of benzoate, or with apiol, which last are said to be exported principally to India for use in kidney diseases.

The plasters formed another portion of the exhibition worthy of notice, especially for the nattiness and convenience of the form in which they were presented. Tin boxes appear to be utilized freely for this purpose, and these would contain in some instances a dozen small circular mustard papers; in others there were rolls of diachylon or salicylated or other plasters, varying from about a quarter of an inch in width and in the smaller sizes retailable at a very small price. In connection with this subject must be mentioned the beautiful cardboard and white birch and beech wood boxes for various purposes, shown by Herr Siegemund, of Berlin, on whose counter a trophy representing Liebig's Hohe formed a conspicuous object, and by Herr Schmitz, of Neusalz-on-the-Oder. Some of the cases, again, were devoted especially to antiseptic dressings, and one very beautiful transparent material for this purpose was shown under the name of "hyaloderma."

The odor from the perfumery exhibits was very perceptible to the nose, but they included nothing of very special interest. The essential oil of ylang ylang (*Unona odoratissima*), the preparation of which at Manila, in the Philippines, is chiefly in the hands of Germans, was shown at the stall of Herr Reymann, of Breslau, together with the oil of champaca flowers. Here was also to be seen a curiosity in the shape of a delicately fine handkerchief woven from the leaf fibers of the pineapple. Herr Hausfield demonstrated the excellence attained on the continent in the manufacture of glycerine soaps, the importation of which into this country has, however, received a severe check in consequence of the presence of alcohol in the soap. One specimen of glycerine soap appeared as a clear liquid. Other soaps shown by the same exhibitor were "sulphur soap," apparently containing some sulphuret, borax, and beech tar soap. Carmine was shown in boxes of which it only covered the bottom, and there was a scented cinchona water.

Of course the ubiquitous firms of Park, Davis & Co. and Cheeseborough were represented, and Seabury & Johnson's plasters and "Sanitas" were among the other exhibits familiar to the English visitor, the last mentioned being in Germany, apparently under the auspices of Messrs. Sarg & Co. There was also a "petrolina" from New York, bearing the alternative title of "petroleum jelly," a name which was long since appropriated and criticised in this country. A large collection of homeopathic remedies was also shown. Among the other miscellaneous preparations worthy of mention were pencils of nitrate of silver, inclosed in cedar wood, like the ordinary black lead pencils, each containing 2·5 grammes of nitrate, and some "molken pastilles," requiring only to be dissolved in boiling milk for the production of curds and whey. As mentioned before, the display of apparatus was small, Oberdorffer's well-known presses, and those of one or two other makers, and an Otto's gas engine forming the principal features. There was a good display of glass bottles from Silesian factories, and also of porcelain vessels for chemical and pharmaceutical purposes from the Royal Saxon Porcelain Works, at Meissen. Finally there were two or three dispensing counters and poison cupboards exhibited, the latter being remarkable for the faith which they evidenced in the efficacy of the symbols of a death's head and cross-bones, stenciled inside and outside on every panel, as an aid to careful dispensing.

DETERMINATION OF SEX, AND THE MENTAL AND PHYSICAL INHERITANCE OF CHILDREN.

By J. MORTIMER GRANVILLE, M.D.

THE laws determining the sex and the physical and psychical inheritance of children are not as well formulated as they ought to be, and the influence of intention, working under and through these laws, is therefore practically *nil.* It is scarcely creditable to science that this should be the case, considering the vast array of facts with which we are surrounded, all pointing to the conclusion that a better and fuller acquaintance with these laws would tend to the improvement of the human race, and the abatement of disease. Nor is the reduction of the laws of procreation and transmission to practice a Utopian project, inasmuch as their broad principles admit of application by individual pairs, and, subject necessarily to the disturbing effect of collateral influences, they will produce the results which science enables the student of the principles of sex and heredity to predicate. It would be impossible within the limits of a short paper to give the evidence upon which the following conclusions have been reached, nor is it my purpose to attempt an argumentative proof of the propositions to be presently stated. A simple summary of facts observed independently, and now for the first time, so far as I am aware, brought together and submitted for consideration in their natural relationship, is all I contemplate. The inferences suggested certainly require, and they admit of proof, but it must be left to time to work that out. I shall content myself with stating two propositions as briefly as the conditions of clearness will allow.

1. It has been shown by direct experiment with the lower animals, and is known to the most expert breeders of stock, that sex is determined by the relative ardency of the two parents. A preponderance of impulse on the part of the male parent produces female offspring, while excess on the part of the female parent produces male progeny. Facts commonly observed in relation to the human species show that the same law governs the determination of sex in man. Among these may be mentioned the following: (*a*) The first children of quickly married parents are generally females. This is particularly noteworthy in the case of men marrying with a strong feeling of personal affection, or an especial desire for heirs. (*b*) Children born as the result of unions in which the female parent is not a consenting party, or is averse from the union, are almost invariably female. (*c*) Female children commonly resemble their male parents in early life, and at the successive periods of change occurring in the course of development and decadence. On the other hand, the offspring of unions or periods, in which the female parent is the more ardent, are nearly always male. (*a*) The first children of parents whose union has been long delayed are generally males; so also are those of unions in which the male parent is not specially attached to the female. (*b*) The offspring of unions in which the desire of the male parent for an heir has become less ardent, while that of the female parent has increased, are generally males. This is a very common experience, whose significance has been strangely overlooked. (*c*) Children born under circumstances in which the female parent is the more exigent are, with rare exceptions, male. Large families of boys indicate the existence of a constitutional excess of the procreative force on the part of the female parent, or a relative deficiency on the part of the male; while a family consisting of girls is proof of preponderance of the same quality in the case of the male parent. When an odd child of the opposite sex is born in the midst of a one-sided family, it is generally weakly, or in the proportional development of its mental and physical systems exhibits the weakness of the force which has exceptionally produced it. Children born late in the life of the dominant parent are frequently characterized by disproportionate development of the mental and nervous, or the more strictly *animal*, parts of the being. Of course, every rule has its exceptions, but the exceptions to these rules are very few. It commonly happens that instances which seem to transgress the general law of sex determination are found on close inquiry to conform to it strictly. I believe that law to be one of the most universally kept, with the fewest exceptions, among the known orders of occurrence—which we call laws—of life and development. Granted the conditions necessary to establish a predominance of the procreative force on one side of the parentage, the offspring will be found of the opposite sex. Thus arises the question of "intention." Assuming that the conditions essential to a proposed result can be established, the event will almost certainly follow the measures taken for its production. This is the first conclusion to which the facts observed obviously point. Sooner or later science will recognize the significance of the lesson they teach.

2. The inheritance of mental and physical qualities, so far as the emotional temperament, the nerve state, and the less permanent characteristics are concerned, follows the line of the force that determines the sex; while the deeper constituent elements of the "nature," elaborated by family influences, pass directly from father to son, from mother to daughter. The new organic result—*i. e.*, the offspring of the union, with its consequential and dependent properties—will be determined by the law that makes all effective power the resultant of the combined forces of which it is composed. The inheritance will not therefore be simply the qualities of body and mind received from the dominant parent, *plus* what the less ardent parent contributes, but will be the mean of the two sets of qualities, in such state of combination as may be determined by the mental concord or sympathy of the parents, and the compatibility of their organic constitutions. With qualities of mind and properties of the organism—so far as these two series of phenomena may be separable even in thought or for the purposes of argument—are transmitted mental and physical defects, weaknesses, irregularities of faculty or form, and consequent abnormal proclivities; the several forms of disease and derangement descending in the same line with the constituent elements to which they are most closely related. Thus, peculiarities of temper, nerve state, and habit, with their morbid tendencies, generally follow the oblique line from father to daughter; while the underlying elements and characteristics, both good and evil, pass directly from father to son, from mother to daughter, subject to the laws of development, to which we will advert presently.

The study in detail of the laws governing heredity has been too much neglected. Had it been pursued with greater care and industry we should not have heard of many strange terms that have crept into use even in technical phraseology. For example, "atavism" does not clearly or adequately express the fact it is employed to denote. The *seeming* absence of certain elements of the hereditary constitution in one generation and their reappearance in the next or a later generation is not a mere accident, but precisely what we should expect under the operation of the natural laws governing sex and heredity. Thus a father may transmit certain peculiarities to his daughter, and she will pass them on to her son, who consequently inherits from his maternal grandfather. The female link in the chain being incapacitated by her sex for the development of certain parts of the *entailed* inheritance, they lie dormant in her organism, to be transmitted, like vitalized but ungerminated seeds, to her offspring when she becomes a parent. That is understood, but that which is not so generally recognized is that this latency is not the simple consequence of incapacity on the part of the daughter to develop the inheritance in her own person, because of her sex; but the result of the repressive operation of other forces inherited by her directly from her mother. There are, in fact, two lines of inheritance—the direct and the oblique. To the former we owe the perpetuation of the likeness of body and mind observed in families bearing a particular name. The force acting in this line is the stronger, or, perhaps, I ought to say the deeper laid and more persistent of the two. This is proved by the preservation of characteristics in the direct descent. The oblique line tends to the dispersion of the inheritance through the daughters of a house and their male children. To make this clear, suppose the existence of two families which we will call respectively A and B. A male of the house, A, marries a female of the house, B, and two children are born, a male, A B, and a female, B A. A male of some other house, say C, marries B A, and has a child, B A C, who inherits the peculiarities of A transmitted through B A, thus dispersing the inheritance of the house, A, through the house, C; but A B, the brother of B A, besides inheriting the surface characteristics of the house of B, obliquely through his mother, receives the deeper underlying qualities of the house of A directly from his father, so that the constitutional characteristics of the family, A, are handed down from father to son and preserved in the direct line with the name. If the energy of transmission were not stronger in the direct line of inheritance, with the descent, than in the oblique, it is easy to see that family characteristics could not descend intact, as is the fact in society. The direct force is superior to the oblique, though the introduction of powerful female elements into the line of descent may do much to weaken it. What we call "atavism" is due to the circumstance

that in the case of a male child, although the energy of the female parent determines the sex and does much to influence the surface type of the organism, the force of the male parent preserves the constitutional type. This enables the male characteristics to reassert themselves in any generation in which the female influence, though sufficient for the determination of sex, is not so strong as to influence the whole course of development. Therefore the latency of peculiarities of constitution is not rhythmical, but irregular, the force directly transmitted generally, however, regaining its ascendency in every second or third generation. The term "atavism" is not so much erroneous or inapplicable as inadequate. It does not explain or even define that which it designates. The laws of inheritance are inseparable from the laws of development, which may be summarized as follows: 1. There is a force operating to produce an animal of the class *Homo*, in obedience to the law of the development of species. 2. There is another force gravitating upon this, the outcome of geographical, climatic, and racial energies and influences, which tends to give the animal so produced a *national* type. 3. There is a force, of which we have been speaking—namely, the energy of *family* exclusiveness. 4. There is the *individual* entity, which embodies the sum of the ancestral energies so far as these have been transmitted or may be revived.

Intention in relation to heredity is the purposive employment, interruption, or control of the laws known to us, for the production of a given result—such as the extinction of disease or deformity, and the engrafting of a healthy stock. It cannot be doubted that science has a wide, and as yet unworked field of enterprise in this department, from which the richest and best fruits may hereafter be gathered. It lies within the scope of the medical profession to attempt the cultivation of this field, but before good work can be accomplished the subject must be investigated and the province thoroughly explored. One of the first and most suggestive considerations in connection with the practical aspects of this subject is that it is by repression as well as desuetude the evil parts of an inheritance are to be destroyed. It seldom happens that a morbid or evil element in the entailed estate of nature can be directly eliminated, but it may be starved and crippled and finally destroyed by repression and exhaustion. We can only eradicate *special* disease by the cultivation of *special* health. It is not enough to keep an inherited defect or evil tendency in abeyance. Some healthful quality or property of the nature should be encouraged to overlie and restrain it. Some sturdy branch must be trained across it. Diseases and morbid tendencies do not die out by virtue of neglect alone. They are only to be destroyed by the cultivation of other characteristics of organic form or function; of "nature" or "habit"—to use vague terms loosely—which have antagonistic or incompatible tendencies. It is not commonly within the power of the physician to make or mar the unions to which affection or policy impels adults; but it *is* strictly within his province and duty to offer advice that shall help to mitigate the evils, and enhance the advantages of such unions as have been contracted. And the family medical adviser can generally find opportunity to direct a course of training—physical, mental, and moral—for children which will tend to the fostering of any inherited, though latent, forces that may be capable of being used to repress or repair the defective traits of the young organism. We leave too much to chance in relation to the propagation of the species and the improvement of the race. "Intention" has a part to play in the determination of sex, and in the revival or repression of inherited forces, by an intelligent use of the laws of nature, which is not yet even recognized.—*Lancet.*

TEMPORARY DEAFNESS.*

By H. AUGUSTUS WILSON, M.D.

IMPACTED CERUMEN.

THE patient before the class to-day is a man aged 45, who says that until one week ago he heard perfectly with both ears, but thinks he caught cold in his left ear by sitting in a draught, because he soon noticed the sudden loss of power of hearing in that ear. He has not suffered with the slightest pain, but has, for some months, been extremely annoyed by noises in the head—sometimes ringing, at other times a crackling sensation.

At times he could not hear his own voice, and upon such occasions he obtained temporary relief by holding his nose and going through the act of swallowing. By this means he was able to force air through the Eustachian tube into the middle ear, which pressed out the membrana tympani. I now take a general look at my patient, and see that he appears to be of a clean habit, there being no evidences about him of careless washing.

I have gathered enough from the history and symptoms to make a diagnosis just as positively as though I had used the otoscope, but I wish several of you to examine the case carefully by means of the mirror and speculum, and see the condition present. It is just as I expected: you are not able to see the membrana tympani; but, instead, you all tell me that there is a dark mass occluding the auditory canal, and you have confirmed my diagnosis of impacted cerumen.

Let us turn our attention from the patient for a few moments and inquire what impacted cerumen is.

Nature has provided a system of glands in the auditory canal, whose function it is to secrete a waxy material for the purpose of keeping the skin lining this tube in a soft, pliable condition, and also the membrana tympani, that it may not get hard and cracked. It also prevents insects and other foreign bodies from coming in contact with the membrane.

This cerumen is naturally quite soft and of a yellow color, but upon exposure to a dry atmosphere or dust, has a tendency to become dark in color, hard, and impacted. This condition may also be caused by a checking of the cutaneous perspiration or ill health.

Paradoxical as it may seem, I will assert that from my observations of quite a number of cases, I believe that the condition we are now studying is frequently caused by efforts injudiciously applied to be scrupulously clean. You may have observed in the shop windows an instrument for cleaning the ears, which consists of a handle of wood, with a small piece of sponge attached. This little instrument has done more to make people deaf than any other appliance I know of, simply because it is improperly used.

The ear lacks that exquisite sensibility to pain which warns us to be careful how we manipulate about the eyes, so that frequently a considerable force is used in cleansing the ears, and that very force packs down more firmly the wax which it is intended to remove, and is apt to cause serious damage to the membrana tympani and ossicles. This little aurilave, which I condemn for its improper use, is really a very valuable little instrument if used with caution and in the proper manner.

Half a drachm of sodium carbonate, dissolved in an ounce of warm water, is a capital wash for the ear, and when applied lightly, by means of a piece of absorbent cotton or a sponge, will remove all traces of cerumen.

It is the habit of some people to use hair pins, quills, pen holders, and such hard, unyielding materials for cleaning the ears; that they are capable of doing damage is beyond dispute, and I therefore warn you never to countenance their use.

After a small mass has become hard, the continued secretion of the wax only tends still further to block up the tube, until, finally, by a sudden draught, or the act of swallowing, it is pressed back upon the membrane; this usually takes place suddenly, and the loss of hearing immediately ensues because the membrane cannot vibrate, nor can the sound waves reach the drum head.

As our view is obstructed, I am unable to tell whether there is disease of the membrana tympani or other structures or not; but as the patient assures me positively that a week ago he heard perfectly, I am inclined to believe that his sole trouble is the impacted cerumen, and its removal will, I hope, give him his former good hearing. I like, for accuracy, to test the hearing power of every case before treatment, and compare from time to time, as it gives me an index to the improvement. There are a number of different ways of testing the hearing, such as by ordinary conversation, the tuning fork, or by the ticking of a watch.

I am in the habit of using the latter in the majority of cases, because I always have it with me. I have used my watch in testing the hearing distance of healthy ears, and have found that a very good average is twenty-eight inches, so that I know just how far my watch should be heard, and by testing my patients, soon learn how far they can hear it; in this way I can record quite accurately in my case book data that will prove of great benefit in the study of the progress of a case.

I will ask you to remain as quiet as possible while I test the hearing of the man before you. You see I hold the watch in the hollow of my hand, and gradually approach his ear until he tells me that he hears it plainly; then I move slowly away until he tells me he can barely hear it; thus I find his hearing in the right ear is perfect; he hears my watch when held twenty-eight inches from the meatus, thus I will record his hearing to be, in the right ear, 28-28ths; the numerator being the distance at which he hears it, while the denominator indicates the distance it should be heard.

Now, in the same manner, I will test his left ear, and you will see that I am compelled to press my watch firmly on the skin over the temporal bone before he hears it; thus I record left ear, $\frac{C}{28}$. (C representing watch in contact.)

The removal of this impacted cerumen is not always as easily accomplished as might be imagined, for the hairs growing in the canal often hold the mass firmly, rendering it necessary to break up and remove in small pieces the wax that is there. This can often be accomplished by the dexterous use of the little spoon attached to Dr. Gross's instrument for removing foreign bodies from the ear.

I shall use, in this case, a modification of this spoon, in the form of the instrument I now show you, which Mr. Snowden has made at my suggestion. It consists of a hollow handle of ivory, at one end of which I carry a spud for removing foreign bodies from the eye, while at the other I have a scoop, which will be found very efficient in removing foreign bodies from the nose or ear. I always carry this compact little combination in my pocket case, and have on more than one occasion derived benefit from its immediate use in cases where I would have been at a disadvantage had I not carried it with me.

In my judgment, the most efficient means is the syringe, with quite warm water, which you see I have applied, with the result before you in a mass of impacted cerumen, showing a cast of the canal. If the simple warm water had not succeeded I should have applied glycerine or a solution of sodium carbonate, which softens the wax, and renders its removal quite easy.

I will now test the hearing, and find, as you all see, that instead of being in contact, my patient tells me that he hears the watch quite plainly when I hold it twelve inches from him, 12-28ths.

The hearing, in cases after removal of impacted cerumen is not, as a rule, as good and as sharp as it will subsequently become, owing, to a certain extent, to the congestion due to the use of the hot water; but as this congestion disappears, the hearing will soon become normal if no other pathological conditions are present.

I will now resort to the otoscope that I may see that all the wax is removed. I find no trace whatever, but, instead, notice that the canal and membrane are markedly congested, the latter being translucent, and otherwise normal. This congestion is temporary, and is due to the application of hot water, and a day will probably suffice to remove all evidences of his late trouble. I will place a pledget of cotton in the canal, that his ear may be protected from sudden atmospheric changes, and discharge our patient with a warning as to the proper method of cleaning his ears.

Gentlemen, in closing, I would express the hope that I have shown you what will teach you that your success or failure in the practice of your profession will depend very largely upon the manner in which you attend to the little things. Observe carefully the minutiæ, and you will be better prepared to battle with the serious trials that will come up for your consideration.—*Medical Bulletin.*

* A clinical lecture delivered in the Eye and Ear Department of St. Mary's Hospital, Philadelphia. Reported by C. W. Smith, M.D., Resident Physician.

THE MAGNETIC APPARATUS OF M. EDARD.

AMONG other electric or magnetic appliances for the treatment of various diseases is mentioned a magnetic sand, which M. Edard imports from the Isle of Bourbon, and which has been subsequently found near Morbihan. Its application is said rapidly to revive diseased plants.

DISTINCTIONS BETWEEN HUMAN BLOOD AND ANIMALS'.

By DR. VINCENZO PESET Y CERVERA.

ON mixing the blood in question with a little bile there are formed in the mass crystals not exceeding 0·003 meter in size. These crystals, according to the author, may be distinguished thus: Those of man are right rectangular prisms; those of the horse, cubes; of the ox, rhombohedrons; of the sheep, rhombohedric tablets; those of the dog, rectangular prisms; those of the rabbit, tetrahedrons; of the squirrel, hexagonal tables; of the mouse, octahedrons; of common poultry, cubes modified at their angles, etc.

PTOMAINES.

WHEN cadaveric decomposition takes place, certain alkaline substances are formed, which are named *ptomaines*, from the Greek *ptoma* a cadaver or corpse. As they are liable to be mistaken for vegetable alkaloids, such as strychnia, veratria, or nicotia, their study presents the deepest interest especially in a medico-legal point of view.

Messrs. Brouardel and Boutmy have recently investigated the question, and, in a paper read before the Scientific Congress of Rheims, throw considerable light on a hitherto obscure and disputed point. The research cannot be said to be complete and final, but great progress is made in an unexplored direction.

The existence of ptomaines has been denied by some, but the writers of the paper affirm that they do exist, and, to prove it, demonstrate the presence of ptomaines both in the viscera of persons whose death was not due to poisoning and in those who died from poison. From a number of cases described by Messrs. Brouardel and Boutmy we only quote the following:

a. The internal organs of a person asphyxiated by charcoal fumes were analyzed a few hours after death, and found free from poison. Eight days later the same viscera were examined, and proved to contain a solid organic base, presenting the general characteristics of alkaloids, and toxic enough to kill, even in small doses, frogs and guinea pigs. This shows that putrefaction gives rise to organic alkaloids when no poisoning has taken place.

b. In this case the authors found a venomous ptomaine in a subject poisoned by arsenious acid, thereby agreeing with Professor Selmi, of Bologna, who, in 1878, met with the same ptomaine in two subjects also poisoned by arsenic. Hence it is seen that ptomaines will form as well in subjects who come to their death without poison as in those who died from the ingestion of a poison, like arsenic, possessing strong antiseptic properties.

The importance of ptomaines in a medico-legal examination is appreciated at once, as well as the interest presented by the study of their mode of formation, nature, and composition. In criminal cases, it is equally important to know by what means the production of these substances can be prevented during the time elapsing between the autopsy and the chemical analysis of the viscera.

The following are the first results arrived at: In general properties ptomaines are similar to alkaloids, and most of the time their toxic action is no less powerful than that of the most deadly poisons.

There are several distinct kinds of ptomaines, completely differing in chemical and physiological character.

To speak only of one aspect of the question, certain ptomaines are violent poisons, while others are not toxic. In a general way it may be said that they are venomous six times out of ten.

Each case of putrefaction does not appear to give rise to distinct ptomaines, for the same alkaloid has been found in the bodies of persons who had died from totally different causes. For instance, the same ptomaine was discovered in a subject asphyxiated by charcoal fumes and another poisoned by prussic acid.

Ptomaines are in most cases volatile, yet they are fixed occasionally. Once, for example, a ptomaine analogous to veratria was found in a body which had been eighteen months in the Seine, and another was discovered in a goose that had undergone the heat necessary for coction.

Certain ptomaines have a toxic effect on man. In an instance quoted, twelve persons who had eaten a tainted goose, containing an alkaloid resembling conia, offered all the symptoms of dangerous poisoning. One of them even died in a few hours, after copious vomitings, although no other cause of death but the presence of ptomaine could be detected. Hence it may be concluded that ptomaines can cause the death of man as well as of animals—as they are known to do. Much time is not necessary for the formation of these alkaloids, for the goose above mentioned had been bought at the market on the very morning of the poisoning accident, and had passed the regulation inspection.

Against the formation of ptomaines, the authors recommend refrigeration as the most efficacious preventive. At the time their paper was written, rooms at the morgue were being arranged to be kept cool with ice-cold air. In these the bodies awaiting a medico-legal examination can be preserved without danger of alteration.

It will be remembered that a short time since Dr. Brouardel acted in his official capacity at the sudden decease in Paris of an English actress well known in this country. The hasty removal of the body to the morgue was not a little criticised at the time, but the present paper explains his action on that occasion. The death occurred under such circumstances as to raise suspicions of poisoning, and in very warm weather. For these reasons it was probably decided to immediately refrigerate the remains, so as to prevent the formation of the deceitful ptomaines. The subsequent examination proved that death was due to natural causes. But had not this precaution been taken, and had poisonous alkaloids been found in the body, the companions of the deceased lady would have been in a position extremely unpleasant, if not dangerous.

Such are the first results of the investigations of Messrs. Brouardel and Boutmy in an entirely new field. Further researches, it is hoped, will enable them to solve the difficult questions which the discovery of ptomaines raises in medico-legal examinations.—*The Druggists Circular and Chemical Gazette.*

THE BOTANICAL NATURE OF WHOOPING COUGH.

IN 1871 Dr. Ludwig Letzerich announced that he had discovered the cause of whooping cough to be a peculiar fungoid growth, which first germinates under the tongue and then rapidly pervades the air passages. Henry A. Mott, Jr., Ph. D., has recently investigated the subject and confirmed the statements of Dr. Letzerich.

Mr. Mott finds quinine to be an antidote by virtue of its well-established power to destroy microscopic vegetable organisms. If this is the true theory of whooping cough, why is the same person not usually subject to repeated attacks? If the growth of this fungus destroys any particular tissue not again renewed—a circumstance not yet observed—would it not be possible to effect the same destruction chemically and thus ward off the disease?

DETERMINATION OF THEINE IN TEA.

FIFTEEN grammes tea are repeatedly extracted with boiling water till completely exhausted; the liquid is filtered, evaporated to the consistence of an extract, mixed with two grammes calcined magnesia and five grammes powdered glass and completely dried.

WILLIAM LASSELL, LL.D., F.R.S.*

By WILLIAM HUGGINS.

THE scientific world will receive with deep regret the intelligence of the death of this distinguished astronomer. The smaller circle of those who knew Mr. Lassell personally will deplore the loss of a friend of rare worth. Mr. Lassell passed away without suffering soon after five o'clock on the morning of Tuesday, October 5, in the eighty-second year of his age, full of years and greatly honored and respected.

In the words of Sir John Herschel, Mr. Lassell "belonged to that class of observers who have created their own instrumental means, who have felt their own wants and supplied them in their own way." The qualities which enabled Mr. Lassell to do all this made him what he was. The work was the revelation of the man. He felt precisely where lay the difficulties and wants which met him in his work, because he was sensitive and sympathetic. He could deal successfully with these difficulties, and supply these wants, often in a masterly and original way, because he could think for himself cautiously and yet boldly. He could work out his conceptions in new and difficult directions to a successful issue, because the constancy of his character showed itself here in concentration of thought and perseverance of action. These qualities, sensitive sympathy, wise prudence, constancy, were those which pre-eminently characterized him as a man and a friend.

In the history of science Mr. Lassell's name must rank with those of Herschel and the late Lord Rosse in connection with that essentially British instrument, the reflecting telescope, whether we consider the genius and perseverance displayed in the construction of these instruments, or the important discoveries which have resulted from their use. About 1820 Mr. Lassell, then in his twenty-first year, began to construct reflecting telescopes for himself. It is, perhaps, to circumstances which Mr. Lassell at the time considered most unfavorable that science is indebted for much that Mr. Lassell has accomplished. At that time he did not possess sufficient means to enable him to purchase expensive instruments, and besides, "his business avocations were such as most men consider of an engrossing nature." The value to him in his subsequent work of the energy and power of resource which were in this way so strongly developed in his character at an early age it is difficult to appraise. His success with the two first instruments which he attempted simultaneously, a Newtonian of 7-inch diameter and a Gregorian of the same size, encouraged him to make a Newtonian of 9-inches aperture. The several mirrors made for this instrument were of great excellence. The observatory note-books of the late Mr. Dawes, which are in the writer's possession, bear record to the delicate tests for figure to which these mirrors were put on the occasions of the visits of Mr. Dawes to the observatory of his friend at Starfield, near Liverpool, where the instrument was erected.

The instrument may be said to form an epoch in the history of the reflecting telescope, in consequence of the successful way in which Mr. Lassell, on a plan of his own, secured to it the inestimable advantage of the equatorial movement.

About 1844 Mr. Lassell conceived the bold idea of constructing a reflector of 2 feet aperture and 20 feet focal length, to be mounted equatorially on the same principle. Mr. Lassell spared neither pains nor cost to make this instrument as perfect as possible, both optically and for the mechanical side. As a preliminary step he visited the late Earl of Rosse at Birr Castle, and commenced the specula for this instrument with a machine similar in construction to that employed by that nobleman. After some months' work he was not satisfied with this apparatus, and was led, in consequence, to contrive a machine for imitating as closely as possible those motions of the hand by which he had been accustomed to produce perfect surfaces on smaller specula. "The essential difference of these constructions," to use the words of Sir George Airy, "as regards the movements of the grinder is this: that in Lord Rosse's apparatus every stroke is very nearly straight, while in Mr. Lassell's apparatus there is no resemblance to a straight movement at any part of the stroke." This is not the place to describe the many new contrivances in the mode of support of the mirror, in the equatorial mounting, and in the polishing machine, which enabled Mr. Lassell to bring this instrument to a high degree of perfection. I must not omit to notice, to use Sir John Herschel's words, "that in Mr. Nasmyth he was fortunate to find a mechanist capable of executing in the highest perfection all his conceptions, and prepared by his own love of astronomy and practical acquaintance with astronomical observation, and with the construction of specula, to give them their full effect." Mr. Lassell was very successful in the great brilliancy and permanency of polish of his metal. Within the last few years the writer has been shown specula by Mr. Lassell which had not been polished for more than twenty years, and which appeared as bright as if but just removed from the polishing machine.

With this fine instrument he discovered the satellite of Neptune. This minute body was first seen on October 10, 1846, but it was not until the next year that it could be satisfactorily followed and its existence fully confirmed.

The superiority of the telescope and the vigilance and skill of the observer were further shown by the discovery, in 1848, simultaneously with Prof. Bond in America, of an eighth satellite of Saturn, of extreme minuteness, which was named Hyperion.

In 1851, after long and careful search, he discovered two additional satellites of the planet Uranus (Umbriel and Ariel), anterior to the two discovered by Sir W. Herschel in 1787. In the autumn of 1852 he took his 20-foot telescope to Malta, and observed through the winter of that year.

A most careful drawing of the nebula of Orion and drawings of several planetary nebula will be found in vol. xxiii. of the "Memoirs" of the Royal Astronomical Society. With respect to the planets, to use his own words, "his discoveries were rather negative than otherwise," for he was satisfied that without great increase of optical power no other satellite of Neptune could be detected. With regard to Uranus he says: "I am fully persuaded that either he has no other satellites than the four, or if he has they remain yet to be discovered."

Mr. Lassell's energy and zeal in the cause of science did not permit him to remain content with this magnificent instrument. His last work was a much larger telescope, four feet in aperture and thirty-seven feet focus, mounted equatorially. This grand instrument was erected at Malta in 1861, and the work done with it, with Mr. Marsh's assistance during the next four years, is fully described in vol. xxxvi. of the "Memoirs." This work consists of numerous observations of nebulæ and planets, and a catalogue of the places of 600 new nebulæ discovered at Malta. It is not possible to suppress a feeling of regret that this magnificent instrument no longer exists.

After his return from Malta, Mr. Lassell purchased an estate near Maidenhead, and erected in an observatory his equatorial telescope of 2-feet aperture. Mr. Lassell's experience in repolishing his 4-foot mirrors suggested to him some alterations in his polishing machine. After his return he was able to carry out these experiments in a workshop erected at Maidenhead, and succeeded in constructing an improved form of polishing machine, which is described in the "Transactions" of the Royal Society for 1874. In 1839 Mr. Lassell was elected a Fellow of the Royal Astronomical Society, received its gold medal in 1849 and in 1870 was elected its president, which office he held for two years. He became a fellow of the Royal Society in 1849, and received one of its gold medals in 1858. Among other honors conferred upon him may be mentioned an honorary degree from the University of Cambridge, and the honorary Fellowships of the Royal Societies of Edinburgh and Upsala.

*Based on an obituary notice written by the present writer for the *Times*.

RARE ANIMALS IN THE ZOOLOGICAL COLLECTION.

THE sagacious founders of the Zoological Society of London made it a special rule that no dividends or gifts of any kind should be distributed among the members. On the contrary, every fellow has to contribute an annual sum toward the maintenance of the society's establishment, unless he prefers to pay a life-composition in lieu thereof. Moreover, the society are so fortunate as to be unencumbered by borrowed capital. They have consequently no burden in the shape of interest to be provided for. It follows that after putting aside from their income a sum sufficient to meet the annual expenditure, they are able to devote the surplus to new buildings in the gardens, and to the acquisition of new and rare subjects for the menagerie. While the supply of lions, tigers, elephants, and other well-known animals must always be kept up for the delectation of the ordinary public, and for the maintenance of the best possible living series of animals, it is also thus in their power to acquire animals of specially scientific value, in which the casual observer would take little interest, and which would, therefore, be quite ineligible except in a scientific point of view. This course of action has been adopted for many years, more especially since the foundation of the office of "Prosector" to the society. For these special acquisitions not only delight the eyes of the intellectual observer while they live, but furnish the prosector with subjects for his studies when dead. Those who are acquainted with the *Proceedings* and *Transactions* of the Zoological Society of London will be well aware of the amount of work that has thus been accomplished as regards the anatomy of many of the rarer birds and mammals.

It is, however, by no means by purchase only that rare animals are added to the Zoological Society's collection. Numerous friends and correspondents in almost every corner of the earth are in constant communication with the secretary of the society, and are ever endeavoring to obtain specimens that may be acceptable to the collection. In fact the donations have of late years become so numerous that they have not unfrequently rivaled in number and interest the objects acquired by purchase. Taking the acquisitions from these two sources together, there are always a considerable number of objects in the society's collection that specially invite the attention of the observant naturalist. Among these rarities there are at the present moment the following, of which illustrations are given, drawn upon wood by Mr. J. Smit, an artist constantly employed by the Zoological Society.

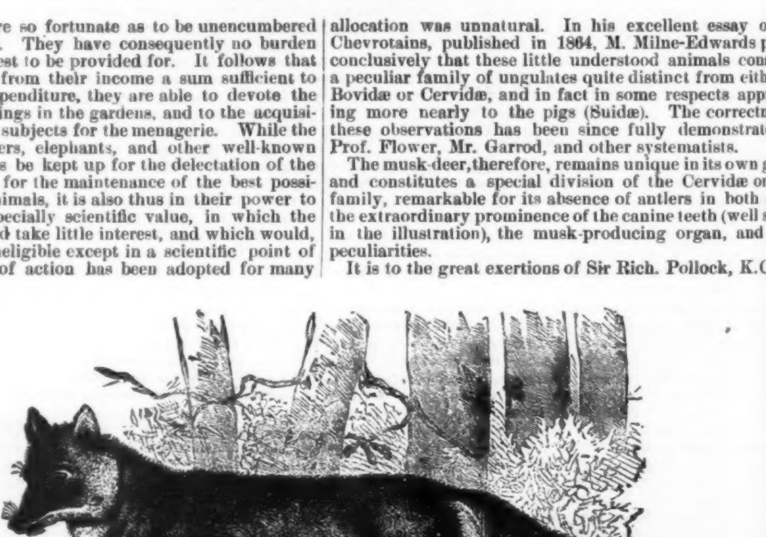
1. The musk-deer (*Moschus moschiferus*) was well known to the older writers on zoology as the animal that has from long periods of time supplied the "musk" of commerce. This scent is still much in vogue in the East, but in Western Europe has been long superseded by more refined perfumes, though it may be remarked that one of the fashionable dealers in Bond street still keeps a stuffed musk-deer in his window, and is doubtless ready to supply the product in question.

The musk-deer was until recently usually associated with another group of mammals to which it has really very little affinity. Dr. Gray and other systematists united it with the Chevrotains (*Tragulus*) of India and tropical Africa—a group of ruminants remarkable for their small size and hornless heads, and presenting somewhat of the appearance of diminutive antelopes. M. Alphonse Milne-Edwards, of Paris, was, we believe, the first naturalist to show that this allocation was unnatural. In his excellent essay on the Chevrotains, published in 1864, M. Milne-Edwards proved conclusively that these little understood animals constitute a peculiar family of ungulates quite distinct from either the Bovidæ or Cervidæ, and in fact in some respects approaching more nearly to the pigs (Suidæ). The correctness of these observations has been since fully demonstrated by Prof. Flower, Mr. Garrod, and other systematists.

The musk-deer, therefore, remains unique in its own group, and constitutes a special division of the Cervidæ or deer family, remarkable for its absence of antlers in both sexes, the extraordinary prominence of the canine teeth (well shown in the illustration), the musk-producing organ, and other peculiarities.

It is to the great exertions of Sir Rich. Pollock, K.C.S.I., lately Commissioner at Peshawur, that the Zoological Society are indebted for their living examples of the musk-deer, the only specimens, it is believed, that have ever been brought to Europe in captivity. A female of this animal was first received from Sir Richard Pollock in 1869. Although it did not live long in the gardens, it gave Professor Flower an opportunity of preparing a most valuable paper on its anatomy.* The same generous donor presented in 1877 a pair of this scarce animal, obtained from the Cashmere Hills, of which the male, now in excellent condition

THE MUSK-DEER (*Moschus moschiferus*). (From a drawing by Mr. J. Wolf from nature.)



THE JAPANESE WOLF (*Canis hodophylax*).

* "On the Structure and Affinities of the Musk-deer *Moschus moschiferus*, Linn.)," by William Henry Flower, F.R.S., V.P.Z.S.—P.Z.S., 1875, p. 159.

and fully adult, still survives, and is the subject of the accompanying illustration.

The musk-deer is found throughout the mountainous districts of Central and Eastern Asia, ranging, as the recent Russian explorers have shown, into Amoorland. Southwards it extends into the Himalayas, but is here, as Jerdon tells us, only met with at great elevations, rarely descending in summer below a height of 8,000 feet, and extending as high as the upper limits of the forests.

Hodgson says that the musk-deer is "solitary, living in retired spots near rocks or in the depths of the forests; they leap well, but cannot climb nor descend slopes well. They rut in winter, and produce one or two young, usually in the cleft of a rock. In six weeks the young can shift for themselves, and are driven off by the mother."

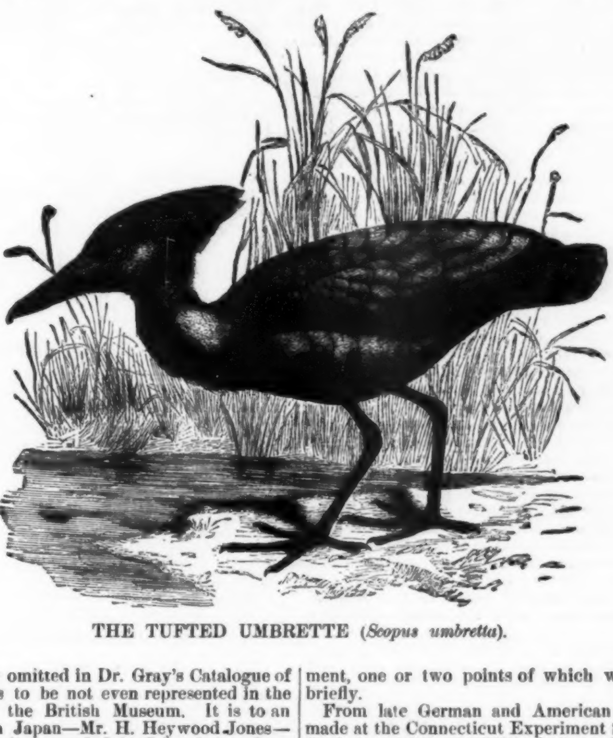
The musk-deer, as stated by Jerdon, is wonderfully sure-footed, and over rocky and precipitous ground perhaps has no equal. It appears to eat chiefly grasses and lichens. If twins are produced the two are kept apart, it being very solitary in its habits, even in infancy. The musk is milky for the first year or two, afterwards granular. The dung of the males smells of musk, but the body does not, and females do not smell of it in the slightest degree. The flesh is dark red, and the young is considered to afford the best venison in India.

The musk-deer is much sought after by the hunter for its musk, many being shot and snared annually. A good musk-pod is valued at from ten to fifteen rupees. The musk as sold is often much adulterated with blood, liver, etc. One ounce is about the average produce of the pod.

2. The species of the genus *Canis* known as wolves—that is, *Canis lupus* and its representative forms—are widely spread over the northern hemisphere, extending in the Old World as far south as Abyssinia (*Canis simensis*) and India (*Canis pallipes*). In North America the larger *Canis occidentalis* take their place in the Arctic regions and Rocky Mountains, but as it goes south, gradually give place to the very distinct prairie-wolf (*Canis latrans*), which seems to range as far down as the Central American Isthmus.

The existence of a true wolf in Japan has been known to us since 1847 from its description and figure in Temminck and Siebold's "Fauna Japonica," under the name *Canis hodophylax*. But this animal has been very little known in Europe except from the specimens in the Leyden Museum, and as it is altogether omitted in Dr. Gray's Catalogue of the Carnivores, appears to be not even represented in the well-stored galleries of the British Museum. It is to an active correspondent in Japan—Mr. H. Heywood Jones—that the Zoological Society are indebted for their unique specimens of this scarce carnivore, which is now very difficult to be procured, having been driven into the recesses of the wooded mountains.

In general form and proportions the Japanese wolf much resembles its well-known congener of Europe, but is of inferior size and more slender make. According to Siebold its native name is "Jamainu."



THE TUFTED UMBRETTE (*Scopus umbretta*).

3. The Tufted Umbrette (*Scopus umbretta*), or "Hammerkop" of the Cape Colonists, is a well-known bird both to natives and travelers all over Central and Southern Africa, but in Europe has only hitherto been recognized as a somewhat scarce object to be found in the principal museums. The example now in the Zoological Society's Gardens, which was acquired a few weeks ago by purchase from a dealer in Liverpool, is, it is believed, the only living specimen yet brought to Europe. The umbrette has been usually placed by systematists among the storks, and by Prof. Reinhardt was supposed to be the nearest ally of the *Balæniceps rex* (without doubt a Ciconiine form). But those who have studied its nimble gait and active habits, as shown in life, will not readily agree to this opinion. Nothing can well be more different from the staid, stolid demeanor of the stork than the lively action of the umbrette, which rather reminds one of a curlew or sand-piper. It is probable, however, that its real place will be found to be among the spoonbills and ibises (Plataleidæ), a group usually associated with the storks, although it must be recollected that the late Prof. Garrod maintained that (as "Schizorhinæ") the Plataleidæ would be better placed with the Limicolæ. When the present specimen dies the question of its position will be quickly decided by the society's prosector, but long may we wait, it is to be hoped, before this event shall happen.

Of the curious nesting habits of *Scopus* we have excellent accounts from Brehm, Heuglin, and other naturalists who have visited the Upper Nile. But one of our own countrymen—a not less active or experienced observer—has likewise written a most interesting account of this bird's economy, and we cannot do better than transcribe a part of it.

"The *Hammerkop* (literally hammerhead)," says Mr. Layard in "The Birds of South Africa," "is found throughout the Colony and all the way to the Zambezi, frequenting ponds, marshes, rivers, and lakes It is a strange, weird bird, flitting about with great activity in the dusk of the evening, and preying upon frogs, small fishes, etc. At times, when two or three are feeding in the same small pool, they will execute a singular dance, skipping round one another, opening and closing their wings, and performing strange antics.

"They breed on trees and on rocky ledges, forming a huge structure of sticks, some of them of considerable thickness. These nests are so solid that they will bear the weight of a large, heavy man on the domed roof without collapsing. The entrance is a small hole, generally placed in the most inaccessible side. The eggs, three to five in number, are of a pure white, axis 1'' 9'''; diam. 1' 4''.

"On my late friend Jackson's farm, at Nel's Poort, there is a singular rocky glen between two hills. In this spot a beautiful permanent spring called 'Jackalsfontein' takes its rise. Of course, in consequence, there are a few wild almond and other trees, and the place is a little oasis amid the barren mountains. It is a favorite resort of wild animals, hyenas, leopards, jackals, etc., and here Mr. Jackson has constructed one of his most successful hyena traps. On the ledges of the rocks in this secluded spot a colony of hammerkops have built for years. Some of the nests are quite inaccessible, while others can be reached with a little trouble. I counted six or eight within fifty yards, and some of them contained at least a large cartload of sticks. Mr. Jackson told me they occupied the same nest year after year, and added to it or repaired it as required. About some that I visited I found brass and bone buttons, bits of crockery, bleached bones, etc. Mr. Jackson said if a 'Tottie' lost his knife or a tinder-box on the farm, or within some miles of the place, he made a point of examining the hammerkops' nests, and frequently with success, the birds, like the 'bowerbird' of Australia, embellishing their dwellings with any glittering or bright-colored thing they can pick up."

NEW POINTS IN THE PRODUCTION OF MILK.

SOME of the recent studies into the secretion and production of milk, and the influence of certain foods, have given a new interest to practical questions of dairy management, one or two points of which we will consider very briefly.

From late German and American experiments, as those made at the Connecticut Experiment Station, by Mr. Armsby, it seems to be established that milk is not simply a secretion from the blood, like the urine in the kidneys or the digestive juice in the stomach and intestines, but is formed in the milk glands from the cells of the gland itself. Or, to state it differently, and perhaps a little plainer, milk is the liquefied milk organ or gland. This conclusion has been reached through many analyses, which show that the composition of the ash of the milk is like that of the tissues of the milk secreting organs; whereas, were the milk simply a transudate from the blood, it would have a similar composition, and could not serve as the exclusive food of the young animal, for in that case it would not contain all the components necessary for growth. As milk is, however, actually, a liquefied animal organ, it is especially adapted to build up other organs. Chemists assert that it is from an examination of what is termed the liquid portion of milk, or skimmed milk, they are led to the conclusion that it is not simply a filtrate, or secretion from the blood. This contains from two to five per cent. of protein; but while the protein of the blood exists as albumen or fibrin, only a very small part of the protein of the milk consists of albumen, most of it being present as casein, a substance not found elsewhere in the body. In addition to the casein, skimmed milk contains from three to five per cent. of milk sugar, or lactose, and this substance, also, has never been found in any other part of the general organism. Hence, it may well be claimed, we think, as chemists have lately come to conclude, that these two substances in skimmed milk, together with the composition of the ash of milk, give it a more peculiar character than it has formerly been known to possess, and are of themselves sufficient to show that milk is not a secretion from the blood entirely, but that it is in fact built up from the cell formations of the milk glands themselves.

To make some terms which we have used more intelligible to non-scientific readers, we may explain that albumen, fibrin, and casein are only other names for certain albuminous compounds in milk or animal organisms, and that protein (about the actual existence of which there has been much discussion in the past, some eminent chemists denying its existence), is a substance produced from them by neutralizing them with an alkali.

A second point of interest in recent milk studies is, that the quantity and quality of milk production are more determined by the development of the milk glands than by the character of the food given; as repeated experiments have proved that with exactly the same fodder one cow will give but little, and another a good deal of milk. A poorly developed milk gland can not be stimulated to great production, even by the richest food; and from this it will be seen that more depends upon a choice of breed for profitable milk production than upon food, notwithstanding it is very common to hear remarks that "feed makes the breed," and "feed makes the milk." This of course, is in part true, at the same time it is well understood that the production of milk, like every other function of the body, requires a certain supply of food for its normal performance, which probably exerts more influence on the quantity of milk than upon its quality. Moreover, a point of much influence is, the quality of the milk gland for rapid cell building in the vesicles (the essential part of milk production) and its ability to yield the desired quality. Still another point of decided influence is the period of lactation. Generally, as is well known, the greatest yield of milk is usually obtained soon after calving. At that time the milk gland reaches its greatest development, and therefore produces the most milk, while subsequently it retrogrades, and the flow is correspondingly less.

A third point of special interest is that of the influence of certain kinds of fodder upon the milk yield. For instance, something a little new is the fact that an increase in the amount of fat forming material in a food has but little effect upon the milk production. This was ascertained by the German experimenter, Wolff, who added a pound of fat per head (consisting at first of rapeseed oil, and afterward of linseed oil), to a very scanty ration of fodder, which had caused a rapid decrease in the flow of milk, increased the flow only for the first few days. On the average of the whole period of feeding, almost no gain was obtained, and the percentage of fat in the milk actually decreased a perceptible quantity, as did also that of the total solid matter. An experiment by another German, M. Kuhn, made with a comparatively rich food, indicated similar results. In this instance, the addition of a pound of rapeseed oil per day, to each cow, caused a small increase, very nearly equivalent to the extra matter given, in the daily milk production, but the percentage of fat in the milk remained unaltered.

From the above outline of a few new points in milk study, it is plain that the most important factors in determining the character of milk yield, are the breed, and the individual peculiarities of certain animals, especially as relates to the properties of the cell reproduction in the milk glands. The best and most abundant feeding is incapable of altering a "cheese breed" into a "butter breed," or *vice versa*. This can be accomplished, if at all, only by continued and intelligent breeding with this end in view, and not by a simple change of fodder. This shows the fallacy of the idea that "feed makes the breed." At the same time it must not be forgotten that the fodder *does* affect the character of the milk to some extent.

These more recent laboratory studies of milk, moreover, also indicate to us the changes that scientific investigation is giving to our knowledge of this product and raising the query as to the possible limit of our researches in this direction. This much is plain: we do not yet know all that is to be learned about the milk-producing machinery of cows, nor the influences to which that machinery is susceptible.—*N. E. Farmer*.

SMALL FRUITS.*

By W. D. PHILBRICK.

THIS term is usually understood to include the strawberry, the gooseberry and currant, the blueberry and whortleberry, the raspberry and the blackberry. The cranberry, too, is one of the small fruits, but since its culture is confined to a few favored meadow lands, its study is not of so general interest as the other sorts, which can be made to grow in any good garden.

The selection of soil suitable for a fruit garden is important, but not always possible. The best soil is a deep black, moist loam, well drained, and having declivity enough to shed the surface water. Most of the soil in this village is too dry and gravelly for the best results; it needs the admixture of peat, clay, or frequent watering in dry weather, and even after much labor in preparation, and after liberal enriching, it will not produce the best kinds of fruit in perfection. There are, however, some kinds of fruits of which mention will be made soon, that are much better adapted than others to poor lands, so that if we cannot choose always a good piece of land for our garden, we may, at least, plant such land as we have with varieties best suited to its peculiarities.

I do not believe in the economy of deep trenching of land for a fruit garden; it is an expensive process, and the raw gravel turned up takes time and heavy manuring to bring it to fertility. A good, two-horse plow works as deeply as most persons care to manure the land; and to turn up cold clay or gravel without at the same time applying a very heavy dressing, is worse than useless.

The strawberry is first in importance, as it is also first in the season to greet us with its luscious red berries. How delicious is its fragrance, how grateful its mild and spirited flavor, in those first hot days of summer, that always bring with them a craving for something fresh and something sour! The apples have gone, we are tired of dried fruit and of rhubarb—we *must have* strawberries.

The most economical, and, in general, the most satisfactory, way of raising strawberries is the common method of the market gardeners; that is, it will produce more fruit with a given outlay of time and money than any other; it will not produce the largest fruit for exhibition—this is not what most people care about. The method is so generally known as hardly to need description. The plants (which should be good runners of the previous year) are set very early in spring, before May 1, if possible. The land is liberally manured with fine compost, plowed under with a small plow, harrowed fine, and rolled; the rows are marked four feet apart, and the plants set twelve inches apart in the row. The space between the rows is sometimes planted with early lettuce or onions, but is usually left vacant to admit of cultivation with the horse; frequent hoeing is followed up until about July 10, when the runners begin to strike; they are directed in their course so as to cover the land as evenly as may be, and sometimes the free growing kinds need thinning, in moist seasons especially. After the runners begin to strike, the weeding must be done by hand, and if the land has been neglected in former years, and is full of foul seed, this is a very laborious job; the prudent gardener will never plant strawberries or onions on foul land. The vines should cover the land by November, and after the

* A paper read before the Newton Horticultural Society.

ground has frozen slightly, they will need a slight covering of sedge, evergreen boughs, or coarse bog hay, just enough to shade them from the winter sun; if covered too deeply they often rot.

Early in spring, about April 20, the covering is raked off and paths cut a foot wide, leaving beds three feet wide. The plants taken up are used for planting a new bed. Little care is needed now till picking time, when, if the crop is a good one, it will need a great deal of care to pick and dispose of the fruit. After picking the bed is usually mowed and plowed under, as it is in general much easier to grow a new bed than to weed an old one. There are, however, exceptions to this rule—some varieties keep over better than others—the Chas. Downing especially, often bears as good or a better crop the second year than the first.

In choosing varieties of the strawberry, we must consider, first, the character of the soil. The Chas. Downing does well on almost any soil, and is almost the only good berry of which this is true. It is, on the whole, the best and most popular kind now well known and tested, and is very fast taking the place of the formerly almost universal Wilson. The Sharpless is a new kind of great promise, but requires better land, as do also those elegant berries, the Jucunda, the President Wilder, and La Constante.

Just as strawberries begin to fail us, the delicious raspberry comes into season. Its culture is simple and easy compared with that of the strawberry, since it can be done mostly by the cultivator and hoe, without that irksome, because enforced attitude of humility required by the strawberry. Few people in these days voluntarily do penance upon their knees for many hours a day in a broiling summer sun, yet this is the price of strawberries.

The raspberry, however, does not yield so quick a return for our labor, not bearing a full crop till two years after planting; but, on the other hand, the plantation will endure for many years without renewal. In our climate red raspberries pay well for covering in winter, and tying up to stakes or wires in spring. The red raspberry also is impatient of poor land. Almost the only kind that thrives on dry land is the Philadelphia, a soft, inferior berry. The Cuthbert is a promising new sort; the Herstine is a good prolific berry; but the best known market berries are the Franconia, an old sort, and the Brandywine, just now in great favor.

The black cap or thimble berries are less particular as to soil than the red raspberries; they do well on rather poor land, and are by no means mean fruit. The Gregg is the largest and best sort. They are rather brambly and thorny in their habit, approaching in this regard the blackberry.

The blackberry! shall we clothe ourselves in buckskin armor and undertake to grow it? It needs some such preparation. One of the best fruit growers told me he gave them up because he could not hire pickers who would do the work faithfully. They need to be laid down like the raspberry, but are so stiff that it is no easy job to do it without breaking the canes. The Wachusett and Snyder are said to be hardy, and need no covering. If this prove true they can be raised easily; they are, however, inferior in size and beauty to the Dorchester and Wilson.

The blackberry is never seen in perfection in market, for the simple reason that it must be picked before ripe in order to bear carriage.

The gooseberry and currant come about the same time as the raspberry, and form not only a pleasant change, but are invaluable for preserves. They are gross feeders, and demand good land, well enriched, and close pruning. No fruit suffers more quickly from drought than the currant, and mulching will be found especially advantageous both for this and the raspberry. The great advantages of mulching are not so well understood as they should be in our capricious climate. Currants and gooseberries should be planted late in fall if possible; they start so very early in spring, that it is not easy to get ready for them in season.

The currant worm, once so much dreaded, is not now much feared by the gardener; a dusting or two of hellebore lays him low. The currant borer, however, is more of a *bore*, and needs a good deal of care in June and July. The Chas. Downing is the best gooseberry, the Cherry and the Imperial Belgian are the best currants; the latter is a late kind, and keeps well till September.

It is rather strange that among all the enterprising gardeners of our time, almost no attention has been given to the blueberry and whortleberry. Indeed, so long as our markets are abundantly supplied with cheap wild fruit, there is little inducement in this direction. Our high bush swamp blueberry, however, is a noble fruit, and has to some extent been cultivated by transplanting the wild bushes. Why can not improvement be made here by raising seedlings, as has been done with the strawberry? Just imagine what a sight it would be to have a high bush blueberry laden with fruit of the size of the Chas. Downing strawberry! Yet he would be a bold man who should say this is impossible, or even improbable.

One word as to the labor required to produce small fruits. Many persons are led away with the idea that strawberry growing and small fruit growing in general is light, easy work, and such as can be done by women and children; it is a delusion. The only women valuable in the fruit garden are the hardy Germans who can do nearly a man's work; and children in general are unable to endure, long at a time, weeding or picking strawberries in a hot sun. The work is not heavy, but it taxes the powers of endurance more than much work of a heavier kind. Picking raspberries and currants indeed is easy, pleasant work, as compared with the other small fruits. But the picking and marketing, to be well done, must be under the constant care of a careful and experienced hand.—*N. E. Farmer.*

Pæonias.—Ellwanger & Barry name and describe in their catalogues forty-two varieties of the tree pæonia, and one hundred and eight herbaceous varieties. Their collection is doubtless one of the finest and most select in the world, and includes among the tree pæonias all shades of rose, purple, blush, red, pink, violet, carmine, and crimson, as well as white—variously shaded, clouded, or otherwise marked. The herbaceous sorts are still more various in color. The large size of the flowers and the extreme hardiness of the plants, freely bearing autumn transplanting, recommend them to all gardens even where they cannot receive much attention. The tree pæonias, after growing several years, make a magnificent display. A specimen on our grounds was three feet high, five feet in diameter, and had at one time seventy flowers, each of which measured five to six inches in diameter.

THE BALSAM FIR.

In his report* to the Regents of the University of the State of New York, Mr. Charles H. Peck, the botanist of the New York State National Museum, has the following:

"The importance of the balsam fir, *Abies balsamea*, Marshall, as an ornamental evergreen and as a source of balsam, renders a brief account of it and its enemies desirable.

"It prefers wet or marshy soil, in cold, hilly, or mountainous regions, yet it is quite at home on comparatively dry upland, and will thrive in almost any soil. Its growth is rapid, but the tree seldom attains a very large size, the trunk rarely exceeding one foot in diameter at the base. Its usual diameter is six to eight inches, with a height of thirty to forty feet. It has a straight gradually tapering trunk, giving off, at intervals of one or two feet, circles of branches, each one of which is a little shorter than the one next below it. This gives to the head or spray a very regular form, resembling in outline an elongated cone. The branches are given off at a wide angle with the trunk. They are generally a little ascending, but sometimes horizontal, or slightly deflexed. The branches are numerous, and given off with considerable regularity at each node, though scattering or adventitious branches and branchlets are of frequent occurrence, both on the trunk and branches. There are usually three regular branchlets at each node, two spreading laterally (one from each side of the branch), and one extending downward and outward beneath the branch. The leaves have been described in some botanical works as two ranked. They are, however, scattered on all sides of the leading shoots and branchlets, and are more or less spirally arranged in their insertion; but those on the lower side of the branchlets are so curved and directed upward and outward that they appear, as a whole, to be somewhat two ranked. They are flattened like the leaves of the hemlock, but are usually longer than those of either the hemlock or spruce. The lower surface is marked by a prominent midrib, and has a silvery or glaucous luster which, combined with the deep green of the upper surface, gives to the foliage a richness and beauty unequaled by that of any other of our evergreens. They remain upon the tree four or five years, so that all the shorter branches are clad with rich, dense foliage throughout their whole extent. The cones or fruit of the balsam are produced on the upper and consequently on the shorter and younger branches. I have never seen them on branches below the middle of the tree. They stand erect on the branches and in this respect differ essentially from the pendulous cones of the spruce and hemlock. On the very short branches, near the top of the tree, they are often so close together that they appear crowded or clustered. Before maturity they are more or less tinged with bluish, or violet and purplish hues, but their beauty is generally impaired by copious exudations of resin. When quite young they are bristly with the long, slender points of the bracts, but these are at length nearly concealed by the overlapping scales. The cones have been described as three to four inches long, but I have never seen them so long. Their usual length with us is one and a half to two and a half inches. Sometimes on the mountains, small trees four to six feet high bear a few cones. This tree, like the spruce, in some situations varies considerably from the typical form. In the Catskill Mountains I have seen it dwarfed to a diffusely spreading bush, similar to the ground hemlock. Near the summit of the high peaks of the Adirondacks it loses its beauty and thrift, and forms dense thickets, in which the trunks are but a few feet high, rapidly tapering and coated with lichens; the branches are long, straggling, crooked, and interlaced, the whole forming a hedgelike mass, through which anything larger than a rabbit would find great difficulty in passing. Starved by the lack of soil, stunted in its growth by the short, cold seasons, pressed down by the weight of accumulating snow, and bruised and cut back by masses of ice and frozen snow hurled against it by fierce blasts of wind, it can no longer attain its usual size and its natural symmetry of form. These mountain thickets of balsam fir are of interest to the botanist, because they show the hardy character of the tree, and its ability to live where few other trees can live; but they are the constant dread of tourists who visit the unfrequented peaks of the Adirondacks, for they are passed only with the utmost difficulty and labor.

"The wood of the balsam fir is of little value for lumber, owing to the small size of the tree. It contains resin and burns freely, but with a crackling noise. The smoke is very penetrating and irritating to the eyes. Near the summits of the mountains, however, it is almost the only available wood for camps and camp fires. The bark of this tree furnishes the well-known 'Canada balsam,' a clear viscid resin of considerable repute in medicine, and much used for mounting objects for the microscope. The resin is obtained from small vesicles or 'blisters' in the bark. It is generally more abundant in the thrifty smooth-barked trees of low damp lands than in the stunted growths of the mountains. Because of the value of this tree as a producer of balsam, and because of its beauty and fitness to adorn parks and pleasure grounds, it ought to be cherished and preserved. But like its companion the spruce, it has its insect and fungoid foes. While at Summit, in Schoharie County, in September, I noticed in a small grove of balsams that a dozen or more of the trees had recently been killed or were then dying. The leaves had nearly all changed their color, but for the most part yet remained on the trees. An investigation showed pretty conclusively that an insect was the cause of the death of the trees. A minute bark-mining beetle, both in its mature and in its larval state, was found between the bark and the wood. The beetle perforates the bark, excavates its furrow along the inner surface in a horizontal direction, and deposits its eggs along the sides of the furrow, which is less than one-sixteenth of an inch in diameter. As soon as the eggs are hatched, the larvæ begin to mine furrows of their own at right angles to the original gallery, one part eating their way upward and another downward between the bark and the wood. These larval galleries are nearly parallel to each other, and are at their beginning so minute that they are scarcely perceptible to the naked eye; but as the larva advances in its course, it increases in size, and the diameter of its furrow increases in like manner. The larvæ were found (in some instances transformed to the mature beetle) each in the larger end of its own furrow. It will be observed from the direction of the original furrow how powerful an agent for mischief this minute beetle is. Its work is carried on in the most vital part of the tree. Three or four beetles attacking the trunk at or about the same height, and on different sides of the tree, would completely and effectually girdle it and destroy its life. Even a single beetle, by extending its furrow entirely around the trunk, would accomplish the same result; but no furrows were found thus extended. The length of the original furrows appeared to be less than four inches. The beetle itself is scarcely more than one line long, and belongs to the genus *Tomicus*. The species is probably undescribed. In the case of the spruce-destroying beetle more workers are necessary to kill the tree, because the main furrows are excavated longitudinally or parallel to the axis of the trunk, while in the case of the balsam-destroying beetle the original furrow is excavated at right angles to this axis, and therefore cuts off or destroys the vital action over a much broader space.

"The destruction of the balsams was not limited to the single grove in which it was first observed. In several places along the road between Summit and Jefferson dead and dying balsams were noticed, but the affected trees were not very numerous, and it would not be a difficult matter, with prompt and united action, to arrest the progress of the mischief. If each man, on whose land the balsams grow, would, as soon as signs of the presence of the trouble are manifest, cut the affected trees, strip off the bark and burn it, he would, by so doing, destroy the colonies of larvæ, and prevent the further spread of the mischief. It is not at all probable that trees once attacked and showing signs of death can be saved, and it would be far better to cut them down immediately than allow them to remain as nurseries for these tiny marauders."

* "Twenty-first Annual Report on the New York State National Museum," 8vo, Albany, 1872, p. 21.

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